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CORONA LOSS FROM HIGH-TENSION AERIAL WIRES.

Until within recent years it was believed that if an energy-transmission line were well insulated the only loss of energy occurring in its use was due to I^2R loss. Consequently, the panacea for all conditions of line loss was to raise the voltage of transmission so as to diminish the current strength I and thus diminish the loss by I^2R. When, however, the voltage of transmission on underground conductors reached 10 kv it was found that, even with well-insulated cables, there was a source of loss additional to I^2R, namely, E^2G watts, where E is the voltage applied to the cable and G a virtual conductance due to dielectric hysteresis. In other words, a well-insulated cable would apparently behave as though it leaked when operated at high alternating voltages owing to a hysteretic lag in the electric flux permeating the insulator, with respect to the impressed cyclic pressure. In the case of aerial lines, however, this hysteretic loss disappeared, the air being, for practical purposes, a perfectly elastic insulator.

Working pressures continued to rise on overhead long-distance transmission lines, and after reaching 40 kv a new source of loss made its appearance. This took the form of a dissipation leakage into the air, not by ordinary conduction or by hysteresis, but by a brush discharge, or corona, wherein the air particles carried away electric charge from the surface of the wires. Up to a certain critical voltage the air surrounding the high-pressure wires insulated practically perfectly. Above this critical voltage the surrounding air broke down electrically and carried away an electric current from the wire by a sort of convection, aided by brush discharges from the surface of the wire. Owing to unwarranted generalization, it was for a time held by some that this effect put a definite limit to high-tension voltages. Later, however, it was found that the value of the critical voltage depends on the size of the wire. A thin wire breaks down the air surrounding it at a lower voltage than a thick wire. When the breakdown occurs in the dark a halo, or corona, is seen to envelop the wire and a faint hissing sound may also be heard—the characteristic murmur of a brush discharge.

In 1904 Prof. H. J. Ryan read a paper before the American Institute of Electrical Engineers on an elaborate laboratory research on the subject of "The Conductivity of the Atmosphere at High Voltages," which has become a classic. His experiments showed the influence of the diameter of the conductor; that the corona developed over a high-voltage wire above a certain critical voltage only, and that it might develop at the peak of an alternating-current voltage wave, but not during the remainder of the wave if the peak exceeded the critical voltage. They also showed that at atmospheric temperatures and pressures not departing greatly from the normal the critical voltage varied inversely as the absolute temperature and directly as the pressure of the air approximately. A formula was arrived at for determining the critical voltage of corona from the size of the wire and distance of the wires

apart, as well as the temperature and pressure of the air. The results of this and other experimental researches on high-tension corona was to show that a very considerable loss of power could take place into the air surrounding a wire above the critical corona voltage. The danger of such a loss was increased on wires passing through high altitudes and over mountains, owing to the reduction in the pressure of the atmosphere surrounding them. The only way to avoid this loss consistent with the necessary high voltage for long-distance transmission would be to use wires of relatively large diameter and to suspend them relatively far apart on the pole cross-arms. Actual measurements of the loss by corona or overhead wires have shown, during the last few years, that they may occur at a voltage considerably lower than that predicted by the above-mentioned formula. Discrepancies of 30 per cent or 40 per cent revealed themselves in this way between the results in the laboratory and results out of doors on actual lines.

At the last meeting of the American Institute of Electrical Engineers Professor Ryan read a new paper on the subject setting forth the theory of the loss by corona, on the one hand, and dealing with the reasons for the discrepancy between laboratory tests and transmission-line tests, on the other hand. This discrepancy it attributed to a combination of a number of elements, such as dirt on the wires, free ions in the neighboring air, radioactive emanations, moisture in the air, etc. It is also partly accounted for by brush discharges, or partial corona formation, in advance of the full corona developed as in the laboratory. Taking all of these influences into account, a reduction-factor of 0.72 is offered in the paper as an average factor for reducing the critical voltage of corona formation in the laboratory to that for the initial stage of well-marked loss of power in actual overhead lines by brush discharge. The greater part of the paper is devoted to an explanation of the phenomena of corona and corona loss of power by reference to the electronic theory. It must be admitted that the theory of electrons fits the observed facts satisfactorily as they are presented in the laboratory. The observed facts in actual overhead lines are so complicated by dirt and irregularities, either on the wires or in the air between them, that the underlying theory becomes concealed.

GENERAL SOLUTION OF OSCILLATION TRANSFORMER PROBLEMS.

A comprehensive general solution for a group of related problems concerning oscillation transformers used in wireless telegraphy is given in an article by Mr. John Stone Stone on page 175 of this issue. In many respects the method employed for attacking the problem resembles that used with problems relating to the so-called "general alternating-current transformer" or "general alternating-current commutator motor." The equations derived from the general alternating-current transformer are applicable to the series transformer, the shunt transformer, the auto-transformer, the constant-current transformer, the induction motor and the induction frequency converter. In a similar manner the equations for the general alternating-current commutator motor are applicable to the single-phase and polyphase series motors, shunt motors, compound motors, repulsion motors, "conduction motors" and "induction motors" of all types. Mr. Stone assumes that the general oscillation transformer consists of two inductive circuits interconnected both by induction and by conduction, and each containing a condenser. Having developed the circuit equation for the general case there is at hand an equation applicable to any form that the general transformer may assume. In applying the general equation to a specific case it is necessary to assign definite values to the "constants" of the circuits. It is in the determination of these constants that difficulty may arise. The author has anticipated this difficulty by describing methods for testing an oscillation transformer of the general type. Although the method described allows one to determine the constants of the transformer tested, great care would be necessary in applying the values thus ascertained to a transformer of the more simplified type in view of the fact that any change in the mechanical arrangement which affects the type alters immediately the constants of even that portion of the circuits which has not been directly changed.

COEFFICIENTS OF REFLECTION.

A point of special interest in the paper presented before the New York Section of the Illuminating Engineering Society last week by Mr. Paul F. Bauder, of which an abstract appears elsewhere, lies in the colorimeter readings obtained with various incandescent lamps illuminating both white and colored surfaces. The data are too elaborate to abstract here, but the thing about them that immediately strikes the attention is that no incandescent lamp, not even a tungsten lamp, gives anywhere near daylight values of color, at least if one takes the standard of the Ives colorimeter as representing daylight. Of unmodified lamps the intensified arc lamp and the carbon-dioxide tube come nearest to daylight, and both these differ greatly in color from any of the gas or electric illuminants in ordinary use. Unquestionably the colors of any of these illuminants can be modified by additive or subtractive processes so as to come much nearer the so-called white than they now do, as with the fluorescent screen of Dr. Cooper Hewitt, the composite gas and electric illumination which was recently proposed and the bluish globes which have been used with Nernst lamps and might be equally well applied to tungsten lamps. This last device is a curious reversion to a practice once not uncommon in the use of kerosene lamps. Some thirty years ago light-blue chimneys for ordinary kerosene lamps were considerably exploited and their effect in modifying the color was both striking and agreeable.

Mr. Bauder investigated at some length the effect of colored wall finish on the color value of the light reflected and found, as might be expected, that a marked effect was produced, yet not enough to afford anything like a complete color correction. It is by no means certain that such a correction, even if very easily obtainable, would always be desirable or agreeable. The glow of a late afternoon sun is perhaps quite as pleasant as the bluish light of a north sky. This is a matter concerning which tastes differ and will undoubtedly continue to differ. From the data given in the paper it is clear enough that in so far as it is desirable to reproduce the tone of daylight it can best be done by illuminants either in themselves substantially white or so combined as to secure the same result. Diffusing wall surfaces are evidently not sufficient to secure the desired result, and suitable screening, although it would doubtless be effective, is open to some criticism on the score of efficiency, since the rays which must necessarily be repressed in order to obtain a color balance are those of high luminosity.

THE EYE AND ARTIFICIAL LIGHT.

A paper by Dr. Nelson M. Black before the New York Section of the Illuminating Engineering Society, an abstract of which appears elsewhere, gives so dispassionate and reasonable a view of dangers to the eye from artificial illumination that it is particularly to be commended. It was Josh Billings, we believe, who remarked: "If there iz ennything I hate it iz a cuss who knows a hull lot of things that ain't so." There is no doubt whatever that since the introduction of brilliant lamps within the last half century there has been more trouble with the eyes, or at least more definitely recognized trouble, than before artificial light was practically available for long-continued work. Man lives and works under artificial light as he did not a century ago, and it is not surprising that he should in a measure pay a penalty for so doing. On the other hand, there has been a vast deal of rather wild hypothesis based on slender experimental data current of late, and it is positively refreshing to find a discussion like Dr. Black's, which frankly admits the things of which ophthalmologists are ignorant and puts forward, not *ex cathedra* statements, but tentative theories backed up by a good deal of ophthalmological evidence. The particular feature of Dr. Black's paper is the stress which he lays upon the injury done to the eye by too bright light. It is a curious fact that too great brilliancy of the visual rays is a factor in ocular damage from artificial light which has been neglected of late in favor of interesting and curious, but not altogether convincing, theories about the malign influence of infra-red and ultra-violet radiations. Now, there is absolutely no question that both these forms of radiation, when received in sufficient amount, may be harmful, but on the other hand it is only under rather extraordinary conditions that it is possible to get enough of such radiations in artificial illumination to do any particular mischief. When ultra-violet rays injure the eye at all it is a superficial injury akin to sunburn and only under very unusual circumstances of long duration. As for the infra-red and red rays, their heating effect is great and it is quite conceivable that when received in sufficient amount injury to the eye would result. Yet only in very rare instances is there enough of this heat effect to cause trouble, and cases of injury that can fairly be attributed to it are very rare.

The theory that the red end of the spectrum is injurious dates back at least some forty years, and found its finest demonstration in the blue-glass craze which ascribed to the light filtered through cobalt glass curative properties that were almost miraculous. Obviously, since cobalt glass lets through the violet and ultra-violet rays, any beneficial result derived from it must have been due, not to adding violet radiation, of which the glass is incapable, but to cutting off the inimical red. The late General Pleasanton, originator of the blue-glass cure, relates with the utmost sincerity his bringing home from the service a decrepit army mule, purblind and afflicted with rheumatism. When the sunshine that streamed through his stable window had been filtered through blue glass his sight was restored and his rheumatism disappeared. This is only one of the extraordinary cures reputed to have been produced by blue glass. Looking at the matter now in the light of cold reason, one does not argue, one simply grins. It was one of the many delusions of pseudo-medicine, like Bishop Berkeley's tar-water and Perkin's "Metallic Tractors." At the present time interest is shifted to the other end of the spectrum, and we find in current literature long screeds regarding the dangers of the ultra-violet only to be averted by the use of somebody's particular variety of protective glass. Now, for one case where infra-red or ultra-violet can get at the human eye in sufficient quantity to do damage, there are thousands where one may be seriously affected by too great intensity of the visible spectrum, and Dr. Black sums up some of the evidence regarding this really very important matter.

The substance of it is that physiologists are practically agreed that seeing is in virtue of some photochemical reaction in the retina. Whether there is only one visual substance, the so-called visual purple, as Dr. Edridge-Green has held, or several visual substances, according to the well-known theories of Hering, is unknown; but it is quite certain that prolonged and intense light puts the retina out of action concurrently with and probably because of its decomposition of the photochemical substance or substances. The retina may be compared to a color sensitive plate in which the maximum photochemical effect is produced, not in the deep blue, as with the salts of silver ordinarily used in photography, but in the yellow, as when ordinary plates are treated with a suitable sensitizing bath. When the access of light is powerful enough to decompose the visual purple or other sensitizing substance faster than it can be regenerated, the part of the retina affected is put out of business, sometimes even permanently, as in the case of eclipse blindness to which Dr. Black refers. Even where the action is not so intense as to produce so serious an effect there is trouble in a minor degree, showing in a good many disagreeable ways only too familiar to those who have been unlucky enough to be thus exposed.

Incidentally, as Dr. Black shows, a good deal of strain is due to conscious and unconscious efforts to exclude the light from the eye chiefly by reflex action of the lids and iris. These are unpleasantly familiar phenomena and are the result of failure to keep bright light out of the eye. They are due in a sense to particular radiations, but these radiations are those very ones to which the eye is most sensitive and which produce the most potent effect on whatever photochemical substances are present in the retina. No amount of cutting off either the red or violet rays as such will make it safe to look at the sun or powerful electric arc for any considerable period or to work with the blaze of a Welsbach mantle or a tungsten lamp shining at short range fully into the eye. Precautions such as the use of diffusing globes and shades shielding the eye from too much light also serve to cut off and diffuse the invisible rays which may have a specific injurious action on the organ of vision. It must not be supposed that even the extreme ultra-violet rays are necessarily harmful, since at the last Ophthalmological Congress at Naples a paper was read indicating that under proper precautions they are not without therapeutic value, and for that matter therapeutic results of apparently some value have been obtained by carefully regulated exposure of the eye at short range to the light from an incandescent lamp. All this, however, is beside the main question and involves matters which the ophthalmologists will have to fight out among themselves. From a practical standpoint, however, Dr. Black has done an extremely good thing in laying stress on the really common source of trouble from artificial illumination—that is, overexposure of the retina to too intense direct light. When this is avoided complaints of injury from artificial illumination will become comparatively scarce.

Convention of the N. E. L. A.

It has been officially announced that the next convention of the National Electric Light Association will be held in New York City, May 29 to June 3. The sessions will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, all of the large auditoriums being available for the purpose during the week of the convention. There will be no official exhibition in connection with the convention this year, and as yet no hotel has been designated as the official headquarters.

Ohio Electric Light Association.

The executive committee of the Ohio Electric Light Association held its annual meeting at the Chittenden Hotel in Columbus, Ohio, on Jan. 11, at which Cedar Point, Ohio, was selected as the place for the next annual convention, with headquarters at the Hotel Breakers, the time to be Tuesday to Friday, July 25 to 28, 1911. The excellent entertainment and large attendance at the convention of 1910 induced the committee to return to this point for its 1911 convention. The convention this year will be even more elaborate in the way of program and entertainment than that of 1910, which was one of the most successful State electrical conventions ever held in the United States. Following is the preliminary program:

Report of the committees on motor application, on electrical transmission and on meters; *Ornamental Street Lighting*, by Mr. O. H. Hutchings, of the Dayton Lighting Company; *Mercury-Arc Rectifiers, Their Installation and Care*, by Mr. J. T. Kermode, of the Cleveland Illuminating Company; *Systematic Central-Station Records*, by Mr. O. B. Reemelin, of the Dayton Lighting Company; *Motor-Driven Refrigeration*, by Mr. W. C. Anderson, of the Canton Electric Company; *Development of a Central Station in Small Cities*, by Mr. S. M. Rust, of the Greenville Electric Light & Power Company; *Pumping Water for Municipalities and for Irrigation by Electricity*, by Mr. B. H. Gardner, of the Dayton Lighting Company; *The Use of Tungsten Lamps in Sign and Outline Lighting*, by Mr. W. B. Gowdy, East Liverpool Traction & Light Company. There will also be a report by the secretary of an investigation of insurance rates charged in Ohio, both fire and liability. The report will state the money this insurance is costing and the losses for the past five years.

The association will publish its souvenir program as in the past. Three banquets will be given by the association on the three nights of the convention to all in attendance, and the entertainment for the ladies will be on a liberal scale. Mrs. Clara Turpen Grimes, the soloist who gave so much enjoyment to all attending the 1910 convention, has consented to return for 1911.

The committee on general arrangements consists of Messrs. E. A. Beckstein, Sandusky, Ohio; T. D. Buckwell, Toledo, Ohio, and W. J. Hanley, Cleveland, Ohio. Further information may be obtained by addressing the secretary, Mr. D. L. Gaskill, Greenville, Ohio.

National District Heating Association.

The executive committee of the National District Heating Association at a recent meeting named Pittsburgh as the place for the third convention of that association, which will be held on June 6, 7 and 8, with headquarters at Fort Pitt Hotel.

The hotel management has made special rates for the occasion and has provided for the meetings and exhibits to be held in the banquet hall of the hotel, which is considered the best room for such a meeting in the United States.

It is anticipated that the program for the convention will be an unusually attractive one to those engaged in heating, whether isolated or district, as the questions to be considered will be in some measure general to the heating business. The subjects so far announced are as follows: "Radiators and Their Treatment"; report of the committee on data, which will include rates and other data pertaining to the heating business; report of the committee on meters; report of the committee on radiation; results of measuring station load by the Venturi and General Electric meters; heating franchises, and five other papers, the subjects of which will be announced later.

The entertainment will be arranged for both gentlemen and ladies attending the convention, and the manufacturers and other members of Pittsburgh have given assurance that it will be enjoyable in every respect.

This convention follows the National Electric Light convention, which will be held in New York City, and it is expected that many of those in attendance at the national convention will attend the heating convention upon their return from New York City.

Further information may be obtained from the secretary, Mr. D. L. Gaskill, at Greenville, Ohio.

Annual Meeting of the Illuminating Engineering Society.

At the annual meeting of the Illuminating Engineering Society, which was held in New York on Jan. 13, it was announced that the following officers had been elected by letter ballot of the whole membership: President, Dr. A. E. Kennelly, Harvard University; vice-presidents: Dr. H. E. Ives, National Electric Lamp Association, Cleveland, to represent the Chicago Section; Mr. T. H. Piser, Welsbach Company, Boston, to represent the New England Section, and Mr. J. T. Maxwell, Philadelphia Electric Company, to represent the Philadelphia Section; directors: Messrs. F. N. Morton, United Gas Improvement Company, Philadelphia; John C. D. Clark, People's Gas Light & Coke Company, Chicago, and Arthur Williams, New York Edison Company; secretary, Mr. P. S. Millar, Electrical Testing Laboratories, New York; treasurer, Mr. V. R. Lansingh, Holophane Company, New York.

Secretary Millar presented the annual report of the council to the membership. The report showed that the membership had increased from 1045 to 1530 during the year 1910. The number of new members elected during the year was 650; there were seventy-six resignations, eighty-two cancellations and seven removals by death. Of the total membership, 60 per cent represent the electrical industry, 20 per cent the gas industry, the remaining 20 per cent representing the reflector manufacturers, consulting engineers, contractors, etc.

An analysis of the 186 papers thus far printed in the society's *Transactions* showed that there were two dealing with acetylene lighting, six with architecture, fourteen with calculations, one with daylight, sixteen with electric lighting, nine with fixtures, sixteen with gas lighting, fifty-two with illuminating enneering, one with illuminating oils, two with pedagogy, sixteeen with photometry, eight with physics, seven with practical research, nine with units and standards, fifteen with street lighting and twelve with vision.

Mention was made of the highly successful results from the lecture course on illuminating engineering at Johns Hopkins University and the annual convention at Baltimore in October. During the year increased interest in the society has been shown by architects, fixture designers, decorators, etc., and it is hoped that they will engage actively in the affairs of the society.

At the dinner, which was served at the Machinery Club immediately preceding the meeting, the guests at the speakers' table included President W. W. Freeman, of the National Electric Light Association; President Hyde, Past-presidents Marks and Sharp, Secretary Millar, Past-treasurer Elliott and Treasurer-elect Lansingh, of the Illuminating Engineering Society. President-elect Kennelly was prevented from being present on account of a lecture which he was delivering in Philadelphia during the evening. Mr. Lansingh, as senior vice-president, assumed charge of affairs for the incoming administration.

Illumination Club of St. Paul.

At a meeting held in the offices of Reed & Stem, architects, St. Paul, Minn., on Thursday evening, Jan. 5, an organization was formed which will be known as the Illumination Club of St. Paul. The object of the organization is the advancement of illuminating engineering and the study of all subjects connected with illumination in any form. In addition to the presentation and discussion of papers it is planned that the club shall be a medium of exchange for general illuminating engineering information and data. The secretary will endeavor to collect from manufacturers and others all available data on various light sources and accessories, and this will be kept for reference by the members. The usefulness of the organization will be extended in other directions if the membership increases according to present indications. A program has been prepared for six meetings, from January to June of this year, and a tentative program has been outlined for the season of 1911-1912. Until further notice these meetings will be held on the second Monday of each month, in the offices of Reed & Stem, 601 Endicott Building. The subject for the next meeting, which will be held on Monday, Feb. 13, is street lighting, and the paper of the evening will be given by Mr. Earle D. Jackson, consulting engineer, St. Paul.

At the meeting on Jan. 5 Mr. Arthur L. Abbot presented a paper on "Some Notes and Data on Illuminating Engineering." Officers were elected as follows: Chairman, Mr. Arthur L. Abbot; secretary, Mr. Clovis M. Converse, 303 North Snelling Avenue, St. Paul, Minn.

Illinois Contractors' Association.

The Illinois Electrical Contractors' Association met at the Hotel La Salle, Chicago, Saturday, Jan. 14, about seventy of the total membership of ninety-eight contractors being present at the sessions. At the morning business meeting matters of handling time and material work, details of estimating, experience on costs, etc., were discussed in executive session, and in the afternoon a "revival" meeting was held, during the course of which nearly fifty contractors recounted their "experiences" in handling the complicated business of equipping human habitations for electricity. Only members of the state and national contractors' associations were present at these sessions.

In the evening the association banquet was held in the Palm Room of the hotel, with Mr. C. R. Kreider, of Kohler Brothers, Chicago, as toastmaster. Mr. Joseph R. Strong, of New York City, spoke on the subject of "The National Association," and Mr. E. Cleary, of Detroit, discussed "Electrical Contracting as a Business." The evening's entertainment was closed with extemporaneous remarks from members of the association, and by professional entertainers imported from the current vaudeville bills at the local theaters. The entertainment committee comprised Messrs. A. S. Schulman, E. Freeman, J. N. Pierce and M. N. Blumenthal.

National Electric Light Association Urges Appointment of Federal Water-Power Commission.

The executive committee of the National Electric Light Association has forwarded to Washington a resolution urgently recommending the authorization and appointment of a committee to consider the subject of federal water-power. The resolution calls attention to the fact that the condition of the laws and regulations relating to the public lands of the United States government is so complicated, unsatisfactory and unsettled that the financing and commercial development of new enterprises in connection with public lands are rendered practically impossible; and that the immediate development of the idle water-powers of the nation is of importance to the whole people in that it brings to immediate use an indestructible natural resource that would be otherwise lost or idle and conserves coal, oil, gas and other fuels that are limited in amount and not subject to replacement. After pointing out that the National Electric Light Association is particularly interested in the situation pertaining to public lands of the United States in connection with the development of water-powers, and that much of the difference of opinion upon the subject of water-powers arises from the difficulty of obtaining a clear comprehension of all the facts, the following recommendation is urged:

"That a competent commission, composed of members of the Senate and House of Representatives of the United States, together with other persons familiar with the financial and other practical aspects of the situation, be appointed with full authority to collect the evidence and for that purpose to hold full and complete open hearings in different sections of the country.

"That such commission be appointed at as early a date as possible to the end that its meetings may be held between the adjournment of the present session of Congress and the reassembling of the new Congress, in the hope that it will report upon such reassembling and Congress be thereby enabled to take prompt action in the enactment of such laws as will permit the development of the natural resources of the country in such a manner as shall render them of the greatest possible use to all of the people."

Telephone Rate Investigation in Chicago.

The Chicago City Council committee on gas, oil and electric light held several hearings last week in relation to the proposed revision of telephone rates. Mr. William J. Hagenah appeared as the expert adviser of the committee, and the Chicago Telephone Company was represented by several of its officers. In addition to matters in dispute to which reference has been made previously in these columns several new features of the discussion were taken up. One related to the cost of underground conduit installed by the company. In Mr. Hagenah's report a valuation of $2,677,425 is placed on the company's underground conduits. This is $718,645 below the figures shown by the company's records, and the discrepancy brought about a spirited discussion in which Mr. J. G. Wray, chief engineer of the company, criticised Mr. Hagenah's methods of determining the value of the company's property. Mr. Wray contended that the unit costs used by Mr. Hagenah were too low and do not represent the actual cost of the conduit construction. In reply, Mr. Hagenah said: "We based our unit costs on the records of the last twelve years. We were unable to get the records prior to that time. Of course, the books show the total amounts expended prior to 1898, but the single records have been destroyed."

At another hearing Mr. Hagenah declared that up to 1907 the company made an annual charge for depreciation, the amount standing on the books at that time for this purpose being $3,767,233. Then by a new system of book-keeping, according to Mr. Hagenah, as reported, the depreciation account was wiped out, and the surplus account was credited with the amount, a stock dividend of $4,500,000 being declared at the same time. The explanation of this made by the company is that the old depreciation account had accumulated between 1889 and 1907 under the old franchise. In 1907 a new franchise was secured, fixing the rates, and for that reason it was thought fair to divide up the old depreciation account among the stockholders and begin afresh.

Another item discussed was the contract under which the Chicago Telephone Company is said to have paid the American Telephone & Telegraph Company $422,326 in 1909. Inasmuch as the parent company owns over half of the stock of the Chicago company, Mr. Hagenah charges that this contract is a device of the majority stockholders to secure larger dividends than the other stockholders. Mr. Sunny, the president

of the Chicago company, said that the association of the local company with the parent Bell company was of very great value to the former, and in his opinion the payment under the contract was not excessive. He is reported to have added that in his judgment if the competing telephone company in Chicago could enter into such a contract, substituting itself for the Chicago Telephone Company, it would be willing to pay $10,000,000 for the privilege.

Tungsten Lamps in Germany.

Consul William T. Fee, of Bremen, has made a report to the Bureau of Manufactures on the commercial status of the tungsten lamp in Germany. It is stated that while the lamp manufacturers are not under strict association rules regarding the output, sale, etc., of their product the prices to the dealer and jobber are held to a certain established point for Germany, but the markets in other countries are open. The prices to the consumer upheld by the union dealers' agreement are as follows: 16-watt lamp, 55 cents; 32-watt lamp, 60 cents; 50-watt lamp, 60 cents, and 100-watt lamp, $1.27. In addition there is a government tax of 5 cents for the 16-watt lamp, 10 cents for the 32-watt and 50-watt lamp, and 15 cents for the 100-watt lamp. There is a customs duty on incandescent lamps which for a 32-watt lamp is about 1 cent. It is stated that the 16-watt tungsten is not giving satisfaction, as the life is too short and the percentage of breakage is high. It is very little used, the 32-watt lamp being the popular unit. One company claims a life of 2200 hours for its lamps, but 1000 hours to 1400 hours is considered a good average life. It is stated that the percentage of breakages of tungstens in shipment from Bremen to Berlin, about 200 miles, is below 2 per cent. The broken lamps received by dealers are immediately returned to the manufacturer, together with the packing case, which does not form a part of the sale. With the next order for lamps good lamps equal in number to the broken ones are shipped without charge. The German export trade in incandescent lamps increased from $2,000,000 in 1907 to $4,780,000 in 1908 and to $7,857,000 in 1909.

Hydroelectric Prospects in Maine.

State-wide rumors of the formation of a hydroelectric power trust in Maine under the name of the Moosehead Power Company have occupied considerable space in the New England papers within the past few days. As a result of the stories spread abroad, President Henry I. Harriman, of the Connecticut River Transmission Company, who maintains headquarters at Boston under the engineering and promoting organization of Chase & Harriman, has given out a brief interview concerning the intentions of the Moosehead Power Company, which is being organized by himself and his associates. Mr. Harriman states that criticisms of the company's plans are as yet decidedly ahead of time, since the bill giving it a charter has not as yet been introduced into the Maine Legislature. When the bill is presented to the legislative committee through counsel the aims of the company will be set forth specifically, and the public will then have real grounds upon which to establish its opinion. Mr. Harriman denied that the Standard Oil Company is in any way interested in the project. He said that the Moosehead Power Company owns flowage rights on the Kennebec River, from the Forks northward to Moosehead Lake, and that it proposes to build a plant with an ultimate capacity of 100,000 hp. Contrary to the popular impression that the State of Maine is to become a mere power plant for New York and Massachusetts factories, it is not proposed to transmit energy outside the State, but to sell it to manufacturers within the commonwealth. Mr. Harriman said that it is intended to form a company to sell energy in bulk and in no sense to inaugurate an electric lighting business. He announced that he is entirely willing to see a public-service commission established in Maine and to have a line of demarcation drawn between his company as a wholesaler and local distributing companies in the way it has been done in Massachusetts under the decisions of the Massachusetts Gas and Electric Light Commission in Fitchburg and Worcester. The development will take a large amount of capital into Maine, and the utilization of resources will be a great benefit to industries. Mr. Harriman said that it is not intended to raise the waters of Moosehead Lake materially, but that the storage facilities to be established by the company on the Kennebec River will be of material benefit to all existing powers on the stream.

Public-Utility Taxation in Boston.

Figures recently made public by the Boston Board of Assessors show that the public-service corporations operating in the City of Boston proper are among the heaviest annual contributors to the running expenses of the municipality. The Edison Electric Illuminating Company paid a tax of $270,046; the Boston Consolidated Gas Company, $233,241; the West End Street Railway Company, $125,271; Boston Elevated Railway Company, $118,757, and New England Telephone & Telegraph Company, $59,111. These companies contributed to the public treasury approximately $1.30 per capita for the population of Boston proper for the year 1910, excluding a vast amount of additional taxation which had to be met in the municipalities surrounding the business area of the Boston district and also excluding various State assessments. The largest personal tax outside the contested portion of the Welch trust estate is paid by the Boston Edison Company, which has a personal assessment of $73,246, based on an appraisal of $12,000,000 on machinery used in plant operation. The assessment on the plant is greater by $1,000,000 than in 1909. The tax of the Boston Edison Company is the third largest of all corporation assessments in the city.

California Legislature to Consider Public-Utility Measures.

At a Republican conference of members of the California State Legislature recently held in San Francisco the committee on public utilities made several recommendations and outlined a measure to bring before the Legislature, which convened in Sacramento on Jan. 2.

A change of the constitution is suggested whereby franchises shall not be granted for a term of years, but shall continue until the State or county or municipality granting the same shall elect to take over the property used in supplying such public service and engage in the business thereof, the several counties and municipal corporations in the State to be authorized to engage in any business to or for which a franchise may be given.

Ex-Governor George C. Pardee submitted the draft of a bill providing for the appointment of a State Board of Control, to consist of the Governor, the State Engineer and three salaried members appointed by the Governor. This board is to grant permits for the use for electric and power purposes of waters not already appropriated. The bill provides that the State board's electric and power permits shall not be for a longer period than twenty-five years. One section abrogates all appropriations of water which have not been put or which are no longer put to some beneficial use. All appropriations are to be subject to the right of the State to fix rates for which electricity and power shall be sold or distributed. Actual construction work must begin within three months after the board's approval of an application for appropriation and be completed within five years. On completion a license for the diversion and use of a fixed amount of water for a definite time is to be granted the applicant.

The license gives a right to no water in excess of the capacity of the works and will be limited to the water actually required for generating electricity or power. Surplus waters can be stored during floods or high water or when not required for

irrigation. Besides $10 for filing an application and $100 for a license an appropriator must make annual payments to the board as follows: For first 100 hp, no charge; next 900 hp, 15 cents for each horse-power; second 1000 hp, 5 cents for each horse-power; above 2000 hp, 2½ cents for each horse-power.

Annual detailed reports must be made to the board. The bill provides that if an appropriator engages in any combination in restraint of trade or to raise or keep up rates his license shall be forfeited. The provisions of the act do not apply to municipal corporations or irrigation districts.

New York Automobile Show.

The eleventh national automobile show given under the auspices of the Association of Licensed Automobile Manufacturers was opened in New York City on Jan. 7. The applicants for exhibition space were so numerous that it was necessary to divide the show into two parts, and even then it was necessary to rebuild and enlarge the three galleries about the amphitheater of Madison Square Garden where the show is held. Last week's exhibit included only gasoline pleasure vehicles and accessories, while the exhibition this week, beginning Jan. 16, is devoted to commercial vehicles and electric pleasure cars, as well as motorcycles and accessories.

Counting the two weeks there are 101 exhibitors of complete motor cars, sixty-nine of whom show pleasure cars and thirty-two commercial vehicles. The exhibitors represent about 80 per cent of the total output of cars in the country. In addition there are 578 accessory and motorcycle exhibits, making a total of 679 exhibits. The four-cylinder water-cooled engine predominates in the gasoline vehicles. The cylinders are cast in pairs with integral water jackets and cylinder heads and in most of the cars a centrifugal pump is used for water circulation. The high-tension magneto is employed in a great majority of the cars for ignition purposes.

Just as in previous shows the gasoline pleasure vehicle overshadowed the electric pleasure vehicle, so in the show this week, from which the gasoline pleasure vehicle is excluded and where the electric pleasure and commercial vehicles are combined, the gasoline commercial vehicle overshadows the combined electric exhibits. It is plainly evident that the commercial gasoline vehicle has become a very strong competitor in the field which has always been looked upon as the one for which the electric vehicle is pre-eminently fitted. The gasoline vehicles on exhibition range in size from a 600-lb. package delivery wagon to a 10-ton truck. All of the manufacturers of electric vehicles, however, are not represented at the show, there being five manufacturers exhibiting in the commercial class and only three in the pleasure class. The former are the General Vehicle Company, the Lansden Company, Pittsburgh Motor Vehicle Company, the Studebaker Automobile Company and the Ward Motor Vehicle Company, while the latter are the Anderson Carriage Company, the Hupp-Yeats Electric Car Company and the Waverley Company. Of the dozen or more commercial electric vehicles shown all are fitted with chain drive and all have a single motor with the exception of two trucks, which are fitted with two motors. The lightest electric commercial vehicle on exhibition is a 700-lb. delivery wagon which the General Vehicle Company, of Long Island City, has placed on the market to fill the demand expressed at the recent convention of the Electric Vehicle Association of America for light-weight wagons for package delivery for retail as well as general department store work. The vehicles as a whole do not differ from those shown at last year's exhibition.

Electric Club at Chicago Electrical Show.

A well-attended luncheon of the Electric Club of Chicago was held on Jan. 11 in the Coliseum during the Electrical Show by the courtesy of Mr. Homer E. Niesz, who is manager of the Electrical Show as well as vice-president of the club. Some of the bread served at the tables was baked in the electric ovens of the Simplex Electric Heating Company at the show. Mr. H. H. Cudmore, president of the Electrical League of Cleveland, was the principal speaker as the result of an interchange of courtesies between the Cleveland and Chicago clubs, Mr. Vose, the president of the latter organization, having previously addressed the Cleveland League. Mr. Cudmore said that the organization in Cleveland is conducted on lines similar to those followed by the Electric Club of Chicago. Meetings are held twice a month, although it is expected that the plan of holding weekly meetings, as in Chicago, will be adopted at some future time. One feature of the Cleveland meetings is the "harmony" singing, which has proved an enjoyable diversion and has served to bring the men closer together.

Mr. Cudmore spoke particularly of the plan of co-operative newspaper advertising adopted by the electrical interests of Cleveland, and he caused to be distributed sample pages of the newspaper publishing these advertisements. An arrangement was made some months ago, as noted in these columns, with the Cleveland *News*, an afternoon paper, by which on every Saturday there is published what is called "The People's Electrical Page." In the center of this page there is a collection of items of electrical information of general interest, and surrounding it are advertisements of electrical manufacturers, dealers, contractors and central-station interests. The idea is that the electrical advertising of Cleveland is thus massed in one broadside, as it were, and is, therefore, more effective. The work is in charge of Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, who is also an officer of the league. Mr. Cudmore closed with a cordial invitation to the members of the Electric Club of Chicago to visit the Electrical League of Cleveland.

Mr. J. S. Badger, general manager and chief engineer of the Brisbane Tramways, of Brisbane, Australia, who has been spending some time in the United States investigating the management of street railways in American cities, was a visitor and spoke briefly by invitation. He said that all the trunk railroads and many of the street-railway and electric light plants in Australia are owned by the government or by municipalities. He believes, however, that the electrical industry does not reach its highest development under government ownership. Public ownership has many good features, but it is undoubtedly true that private enterprise supplies that initiative which makes for the greatest degree of enterprise and development. Mr. Badger spoke of the remarkable progress in street-railway service in Chicago since he visited that city some fifteen years ago. The street-railway systems of Australia are small compared with those of the United States, and the speaker gracefully expressed a sense of obligation for being permitted to study freely many examples of American development.

Messrs. George. H. Porter and Thomas C. Ringgold spoke briefly. The treasurer's statement was submitted, showing that on Jan. 1 the Electric Club of Chicago had $3,222.35 in its treasury.

Annual Dinner of St. Louis League of Electrical Interests.

The second annual meeting of the League of Electrical Interests of St. Louis was held at the Missouri Athletic Club on Jan. 10 and was an enjoyable affair. It was also the occasion of the annual dinner of the society, and several unusual "stunts" were presented. The invitations were sent out in blueprint form and recipients were told that the "feeder" would be of 100,000,000 circ. mils, with resistance nil. The souvenir menu was also provided with a blueprint cover with a clever design, and the sheets were tied together by silk-covered lamp cord. Three hundred members were present and puzzled themselves in endeavoring to discover what "impregnating compound," "glazed porcelains," "transformer oil" and other electrical terms meant in the way of things to eat and drink.

The dinner was followed by lantern-slide cartoons of many

present, the bright light of publicity being thus thrown on the counterfeit presentments of the speakers while they were addressing the assemblage. There were also several vaudeville acts by professional performers. Capt. Robert McCulloch, the retiring president, occupied the chair. Mr. H. H. Humphrey, consulting engineer, was elected president of the league for the ensuing year and Mr. F. D. Beardslee, commercial engineer of the Union Electric Light & Power Company, was elected secretary and treasurer, succeeding Mr. Walter Robbins. A number of out-of-town guests were present, including Messrs. W. A. Bixbey and N. J. Cunningham, of Springfield, Mo.; P. E. Murray, of Louisiana, Mo.; H. B. Shaw, of Columbia, Mo., and R. J. Irvine, of Marshall, Mo.

Operating Details of Chicago Commonwealth Stations.

A larger hall having been found necessary for the monthly meetings of the Commonwealth Edison Branch (Chicago) of the National Electric Light Association, the meeting on Jan. 10 was held in Recital Hall, with an attendance of fully 300. It was decided to adopt a distinctive badge of membership. Two other branches, those in Brooklyn and Philadelphia, have also adopted badges. The Chicago badge will consist of the N. E. L. A. bronze button in the center, encircled by the words, "Commonwealth Edison Company Branch," on a background of red, white and blue. It is believed that the badges of the different branches will be particularly useful at the annual conventions of the whole association. It was announced that the evening of Jan. 20 will be "N. E. L. A." night at the Chicago Electrical Show, and that free tickets will be given to the members of the branch by the courtesy of the Commonwealth Edison Company. The Chicago branch is growing satisfactorily, and it now has 762 members.

Two papers were read at the meeting. The first was by Mr. P. B. Juhnke, whose subject was "Generating and Transmission Systems and Load Dispatcher's Office." Mr. A. E. Evans followed with a paper on "Substations and Distributing System." These papers are part of the series of descriptions of the work of the various departments of the Commonwealth Edison Company, which is the feature of the season's program of the branch. Both papers were illustrated by lantern slides. Mr. Juhnke described the generating stations in outline. He made a number of interesting statements, such as the fact that the total quantity of water in a boiler at Fisk Street is boiled over about once in two hours at full load. The speaker also remarked that the direct current generated as such amounts to only 2 per cent of the total amount of electricity generated. Mr. Juhnke paid considerable attention to the transmission lines and load-dispatching system. There are fifty-three substations and nearly all have two incoming lines, so that one will be available if the other breaks down. The technical control of the immense system of the Commonwealth Edison Company is centered in the load dispatcher's office. Here there is a wall diagram showing every 9000-volt, 12,000-volt and 20,000-volt switch on the system. Plugs of different colors are used to indicate the character and condition of these switches, and not one of them is opened or closed without an order from the load dispatcher. There is also an elaborate system of charts and records. No apparatus connected with the generating, transmission and distributing systems can be touched for repair or removal without a permit from the load dispatcher, and the average number of such "load dispatcher's permits" in force at any one time is about fifty.

Mr. Evans described the various types of substations and the apparatus, as transformers, rotary converters, storage batteries, frequency changers, etc., installed in them. The largest rotary converters are of 2000 kw rating and are both of the vertical and horizontal types. The storage batteries of the various substations have a total rating of about 20,000 kw. The various substations designed for particular classes of service, as railway load, industrial plants and commercial service, were described.

In the discussion Mr. Edwin Jowett, of the Fisk Street station, made the interesting statement that 10 per cent of the water in the South Branch of the Chicago River passes through the condensers of that great electrical generating plant. If there were any way of utilizing the heat wasted in the condenser discharge it would be possible to operate five plants of the size of the Fisk Street station. Mr. John F. Gilchrist remarked that the heating of the water in the South Branch of the Chicago River by the Fisk Street and Quarry Street stations actually was of appreciable benefit to the Economy Light & Power Company on the Desplaines River at Joliet and no doubt to the Sanitary District on the Drainage Canal at Lockport in the operation of their hydroelectric plants. Since the two great steam plants have been in full operation the heated water they discharge into the river has had the effect of ameliorating very largely ice troubles at the water-power stations mentioned. "Thus," said Mr. Gilchrist, smilingly, and referring to the Sanitary District, "we are actually warming the water used by a competitor, so that it may operate its plant more effectively in winter."

Others taking part in the discussion were Messrs. W. J. Weyker, W. Goodykoontz, G. C. Spencer, U. Davis and D. D. Higgins. An orchestra, composed of company talent, gave some music before the meeting was declared adjourned.

Cedarmen in Convention Report Decrease in Pole Stocks.

A large decrease in white-cedar pole stocks from the 20-ft. lengths up was reported at the fifteenth annual session of the Northwestern Cedarmen's Association, held at the Hotel Radisson, Minneapolis, Jan. 10 and 11. Twenty cedar producers were represented at the convention and the stock report of present poles on hand showed a decrease of nearly 40 per cent, or 800,000 pieces, compared with the stock of a year ago. All sizes are thus cut down to a point where, with reasonable trade for the next few months, the old stocks will be pretty well cleaned up before the new stock is in shipping condition.

The estimated production for the present season indicates a total of about 600,000 pieces from the 20-ft. lengths up. If this estimate is correct the available supply will still show a shrinkage of 200,000 poles. In any event a sharp decrease in stocks on hand during the coming season is predicted by the pole men.

Posts show a decrease of 38 per cent. The input of posts during the present season will come close to 10,000,000. The stocks of 4-in. and 5-in., 7-ft. posts are low and these sizes are selling at list price and better.

A few changes have been made in the present pole specifications, but these are comparatively unimportant.

Poles 4 in. x 25 ft. have been included with standard telephone and telegraph poles and will take the same specifications. Circumferential measurements are 12 in. for dry and seasoned 4-in. tops and 12.5 in. for green stock. The top measurement for 20-ft. poles will be the same as in the longer sizes. Hereafter the measurement for crook in 20-ft. poles will be taken from a point 4 ft. from the butt instead of from butt to top as formerly.

President T. M. Partridge opened the convention with an address, and reports were heard from the officers and committee members. The association banquet was held at the Hotel Radisson Tuesday evening, fifty being present.

The Wednesday morning session was devoted chiefly to discussion of protection from forest fires and the framing of a bill to be presented to the Legislature prohibiting insurance companies from canceling policies on ten days' notice in times of danger from fires. The bill will ask for ninety days' notice.

The officers of the Northwestern Cedarmen's Association elected for the ensuing year were: President, Mr. T. M. Partridge; vice-president, Mr. E. C. Norton, Escanaba, Mich.; treasurer, Mr. W. B. Thomas, Manistee, Mich.; secretary, Mr. H. H. McKinney, Minneapolis; directors, Mr. J. W. Benham, Chicago, and H. S. Gilkey, Minneapolis.

Discussion on Luminous Efficiency at Chicago.

On the evening of Jan. 13 the members of the Chicago Section of the Illuminating Engineering Society were the guests of the Electrical Show management and took dinner at the Coliseum restaurant. The evening's discussion was on the subject of Dr. Herbert E. Ives' paper on "Luminous Efficiency," presented before the Philadelphia Section Jan. 21, 1910. Preliminary to the discussion an abstract of the paper was read by Mr. A. L. Eustice. Dr. Ives' paper is a classical compilation of the results obtained by himself and other investigators from studies of the luminous portions of the spectra of various illuminants, in which the superior value of certain wave-lengths in producing light as a physiological sensation is pointed out. After indicating the consequent necessity of some equivalent measure, such as "reduced luminous efficiency," a term which the author coins, he concludes that absolute luminous efficiency, measured in percentage of utilized energy at the wave-length most efficient in a physiological sense, is still a quantity for future investigation and suggests that the "lumens-per-watt" of the illuminating engineer is exact and satisfactory as far as it goes. Dr. Ives also advocated a simpler terminology as being necessary to advance the understanding of the subject.

Mr. James R. Cravath opened the discussion, calling attention to the difficulty of arriving at an accurate determination of the "mechanical equivalent of light" in lumen-hours or candle-hours per watt-hour, although the mechanical equivalent of heat is a well-known quantity. For the comparison of modern illuminants, however, such determination is not absolutely required. Mr. Cravath then reviewed the table of luminous efficiency of various light sources compiled in the paper under discussion and remarked on the very low efficiencies of the best electrical artificial illuminants. This table follows:

Source.	Spherical Candles per Watt.	Lumens per Watt	Per Cent Reduced Luminous Efficiency.
Ideal yellow-green source	50.00	625.0	100.0
Firefly			96.5
Black body at 6000 deg.	7.50	95.0	15.6
Carbon filament ("4-watt")	0.21	2.6	0.43
Tungsten filament	0.63	7.9	1.3
Direct-current arc	1.10	13.8	2.2
Yellow flame arc	3.00	37.8	6.0
Quartz mercury arc	3.40	42.8	6.8

Dr. Morton G. Lloyd declared that the term "mechanical equivalent of light" is meaningless without including modifications, since light iself is not energy and hence cannot be compared by a simple numerical ratio with the electrical energy which produces it. A better expression, thought Dr. Lloyd, would be "mechanical equivalent of radiation," since radiation expresses the idea of energy. The same reasons led him to conclude that "luminous efficiency" is also meaningless without modifications. The speaker remarked that unfortunately many able scientists do not give proper consideration to the physiological aspects of light production. For example, the sensation produced in the eye does not vary directly as the incident light, the color of lights of equivalent intensities having an important bearing on the degree of brightness which the eye perceives. The first-mentioned principle indicates that, in a physiological sense, illumination does not obey absolutely the familiar inverse-square law. In the balanced photometer screen, when illuminations of equal intensities are compared, this difficulty does not enter. The unequal visual sensations produced by differently colored lights of equivalent intensities can be shown by balancing the sources at one pair of positions and then doubling the distance of each source, with the result that the balance will no longer continue.

Mr. G. C. Keech remarked on the admirable color qualities of daylight as suited to the human eye, although Dr. W. C. Bauer, of Northwestern University, who was present, observed that the quality of daylight is at no time really constant for any hour of the day or day of the year. Prof. E. H. Freeman, of Armour Institute, declared that an agreement must be reached on the matter of nomenclature, deciding whether "light" is to be considered in its physiological or purely physical aspect.

The subject to be discussed at the next meeting of the Chicago Section of the Illuminating Engineering Society, "Illumination Problems in Small Cities," is expected to be of special help to central-station managers in the smaller towns, where the expert services of illuminating engineers are not available. The author of this paper has not yet been selected, but the discussion will tell of the work done by small-station managers in improving their local lighting conditions.

Fixture Design and Glare.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on Jan. 9. Chairman C. O. Baker presided. Papers were read by Mr. David Crownfield, chief fixture designer of the Pettingell-Andrews Company, Boston, on "The Illuminating Engineer and the Fixture Designer," and by Dr. Percy W. Cobb, of the physical laboratory of the National Electric Lamp Association, on "Physical Points Bearing on Glare."

Mr. Crownfield emphasized the point that the fixture designer has had little to do in the past with the location of outlets, but that a proper treatment of illumination problems demands a change from this condition. The problems of artificial lighting are extremely elusive, and personal skill in the selection of apparatus and methods is of paramount importance. The standards are constantly rising, and the introduction of highly artistic shades adapted to the special treatment of diverse lighting needs renders the location of the outlet an important part of the solution in each case. It is a mistake to suppose that all is well when the illuminating engineer has flooded a given area with light. The temperament of the fixture designer naturally tends toward the artistic side of the illuminating problem. Both the artistic and scientific sides of the question must be taken into account for a proper result, including a reasonable cost of lighting and the use of artistic light carriers and fixtures.

The principal considerations affecting the illumination of any interior room or area are: First, the use of the room; second, the selection of the kind of lamp best suited to the use of the room; third, the proper quantity of light required for such use as the room may be put to, either specialized or general; fourth, the location of the outlets at such points that the light will best perform its office; fifth, the satisfaction of certain esthetic requirements which are inherent in every lighting problem, and, sixth, the selection of a fixture of such a type and nature that it will properly perform its office as a light carrier and also be designed along lines which will be esthetically satisfactory with regard to its environments. The use of the room is profoundly important in its relation to illumination, and a wide range of requirements is manifested, covering those of public and semi-public buildings, such as banks, art galleries, apartments, clubs, churches, theaters and private residences and commercial buildings in general. In considering the kind of light desired cost is important, together with consideration of the necessity of changing the light-giving medium for special requirements. In library, theater, home, church and hospital lighting cost should not be the prime factor. The important point is quality of light or its effect on color. Strict color requirements in certain installations of necessity limit the use of mercury-vapor lamps, glower lamps and other specialized illuminants. Adaptability of the height of the lamp to its surroundings is most important. Where the conditions require that the illuminating equipment should exemplify specific style and standards of taste care should be taken not to multiply styles in a single room. The quality of light should ever be the dominant factor.

Quantity of light must be considered with respect to the en-

tire range of conditions demanded by the installation. The work of the society will tend to arouse an interest in good illumination on the part of the public as time passes. Mr. Crownfield said that, in his opinion, the single unit, high-wattage lamp is objectionable for most interior work except within its limited sphere, which lies in foundries, depots, post offices, packing-rooms, stores and other large areas where more or less rough work is done under conditions requiring a bright general illumination. Ballrooms, opera houses, salons and theaters require a wide range of illumination between a high brilliancy and clear relief of special objects of interest. The limit of brilliancy is the point of obtrusiveness where illumination becomes intense. Mr. Crownfield said that the lighting should never be the dominant feature of a room. The limit of dimness should be where people are aware of each other's presence, but not of mutual individuality. Without in any sense disparaging scientific research into lighting problems, Mr. Crownfield stated that it is often helpful to consider lighting on a scale as follows: Dim, low diffused, good general illumination, reading light, strong reading light, brilliant and finally intense illumination. Outlets should never be equipped to furnish a permanently dim light, except in hospital wards, libraries, clubs and in halls and corridors of private houses and hotels. A dim lighting effect is also desirable in church auditoriums where altars are used, with provision for high light in certain altar applications. Brilliant lighting is required in ballrooms, hotel lobbies, dining-rooms, hospital operating-rooms, gymnasia and other places where people go to be seen. A good reading light is desirable in the waiting-rooms of stations, theaters, libraries, at the entrances of court houses and in lecture halls. Mr. Crownfield criticised the tendency toward extreme brilliancy in the lighting of amusement entrances, notably picture shows.

The importance of studying the effect of lighting on the colors of walls and ceilings was emphasized. Depth of illumination may be added to any space by the proper location of outlets In banks, governmental and municipal buildings considerable uniformity in outlet location is desirable, with special treatment of the larger spaces by chandelier fixtures harmonizing with the minor brackets. Usually from five to seven outlet groups are required. Particular care must be paid to architectural harmony under present-day conditions. Outlets in churches should be arranged to bring out the architectural features of the buildings, at the same time avoiding any direct glare from illuminants so far as possible. The Colonial style of church is cheerful and can be lighted with good effect artificially by placing outlets in the ceiling for chandelier service and adding a line of brackets one each side under the gallery against the wall between the windows. Romanesque and Gothic churches should be lighted by outlets on beams or columns, with special lamps behind the sanctuary arch or over the chancel space. In clubs and also in residences there should be enough outlets to enable the lighting to be brilliant on occasion. The lighting of private houses is often defective on this score. A 40-watt lamp should be the maximum limit of any residential outlet. In living-rooms one center outlet with from two to six side outlets and a floor plug should be provided. In bedrooms there should never be less than two lamps beside the dressing-case and preferably one over it also. In closing Mr. Crownfield exhibited drawings in color of recent artistic fixture designs.

Following Mr. Crownfield's paper a short discussion on indirect lighting was held. The case was cited of a room 13 ft. square which had recently been equipped with four 60-watt outlets and inverted prismatic shades. The illuminating engineer who handled the work claimed that a person with ordinary eyesight could read easily with two outlets in service, and that another with poor eyes could read in comfort with four outlets in circuit. Most of the speakers criticised the use of indirect lighting for reading. Mr. Crownfield stated that it has a tendency to annihilate all the ceiling color and that better diffusion would be obtained by a reading lamp. Replying to a question he stated that the most artistic fixtures known were designed in the Bourbon and Georgian periods, and that it is perfectly proper to make the fixture the highest decorative note in the room. Mr. W. H. Blood, Jr., Boston, said that many contract agents think that their duties are contained in selling quantity of light, which, as a rule, means glare, and that few realize the importance of the artistic side of illumination. He considered indirect illumination of the type discussed almost a barbarism. It gives an unpleasant feeling in a room and, while it is used to some degree around Chicago and elsewhere, it is dull. Some bright spots are needed. The depressing effect of indirect illumination has frequently given rise to severe headaches, and it is extremely difficult to make indirect lighting artistic. Dr. Louis Bell, Boston, stated that the use of four 60-watt outlets in a room 13 ft. square gives an extraordinary illumination. He commented on the low efficiency of indirect lighting. Mr. Preston S. Millar, New York, spoke of the acceptance of indirect lighting on the Pacific Coast, where most of the criticisms have been aimed against the poorly installed systems. He thought that the indirect method has a certain small field of its own.

Dr. Cobb presented an exhaustive paper on the physical aspects of glare, discussing the structure of the eye in relation to disturbances from side light. He did not consider that general illumination is ever carried too high, and in nature it is only in certain rare cases, as with sunlight on snow in high altitudes, that serious intensities are ncountered. The relative over-brightness of a part of the field of vision on the retina may contribute to confusion of vision. Dr. Cobb brought out the point that, as a rule, the human observer prefers to have the upper portion of his field of vision dark in comparison with the rest of the field. He described the muscular adjustment of the eye to meet the conditions imposed by varying disturbances at different angles of vision. A light source in the field of vision is like a loud sound, severe pain or sharp stimulus to the skin. Too high a brilliancy of isolated foci may produce retinal irritation. The incandescent carbon filament is too bright to maintain in the direct field of view. Dr. Cobb said that the praise often given the kerosene lamp as an illuminant arises from the fact that there is usually nothing bare visible, the mechanical structure and heat of such a lamp compelling a reasonable distance between it and the reader's head. He discussed the adaptation of the eye to strong light and pointed out that exposure to high illumination causes a loss in sensitiveness. Dr. Cobb reviewed mathematically the relations existing between the brightness of walls and the light upon work being performed, stating that as long as the details of the work are clear the light on walls should not exceed that on the work itself. He further described researches in Germany and the United States on the subject of visual acuity, emphasizing the relation of visual acuity to variations in intensity of side light. Tests show that an angle of about 25 deg. is the maximum at which visual acuity is substantially affected by the introduction of a disturbing side light. The experiments of Sweet and Millar in America were briefly touched upon, and the effect of scattered light within the eye discussed briefly. So far as scattered light reduces visual acuity it does not appear inimical to the eye itself. The reduction of visual acuity appears to be greater when the rays of light from a side source fall upon the blind spot in the retina than when side light falls upon the illuminated section of the retina.

Air and Oil as Dielectrics.

In a paper that in many respects was supplementary to his paper on "The Conductivity of the Atmosphere at High Voltage," which was presented in 1904, Prof. Harris J. Ryan, of Leland Stanford, Jr., University, California, described the formation of corona in air and the rupturing of oil by dielectric stress at a meeting of the Amercan Institute of Electrical Engineers held in New York on Jan. 13.

Tests have shown that initial corona is dependent not only

on the application of a certain minimum stress, but also upon a certain minimum distance through which such stress must be applied. This distance, designated as the "striking distance," is shorter for smaller diameters and longer for the larger diameters. Below the "striking distance" the stresses required to produce corona or spark-discharges are increased above the value required for the critical striking distance. The critical stress value is reached at 76,000 volts per inch within a zone of 0.07 in. from the surface of the conductor. When uniformly distributed, 76 kv per inch is the critical stress required to rupture air in bulk, but a larger stress is required to rupture thin films. This fact points strongly toward some dynamic action that requires a critical minimum combination of stress and distance through which to bring about rupture wherein any foreshortening of distance must be compensated for by an increase in stress.

Professor Ryan presented evidence to show that electric stress is merely one of several factors of importance in the production of corona and spark discharge in air or in gases generally. He discussed in detail the theory of ionization by collision, and thereby accounted for the great dielectric strength of thin envelopes of air.

On the basis of the ionization theory, Professor Ryan showed that ionization and the travel of ions under electric stresses are the cause of failure of the open atmosphere as an insulator and they are the cause of corona formation. All ordinary failures of the atmosphere under stress are developed through ionization by collision which can be started under usual high-voltage electric stresses through the presence of some natural or antecedent supply of ions. Variation in the supply of natural ions in open air is the cause of the erratic variation of critical loss-voltages; such variations have little effect upon the values of the part-corona voltage that has increased the atmosphere loss by the small amount equal to the loss caused by the inevitable ion-convection current. The figure of the electric field about the high-voltage conductors determines the facility with which the migrating ions will concentrate the electric stress near the surface of the conductor and thus render the resulting corona irregular at all stages, causing it to be started and to be maintained at correspondingly lower voltages. The turbulent elements introduced by variations in the amount of natural ionization have so small an effect upon the corona-forming pressures and the field irregularity factor above referred to is so nearly constant over a wide range of conditions that the rational formula as developed should be found dependable to a reasonable extent. The term *"dielectric strength"* as applied to the oper atmosphere, from the inherent nature of things, can have no definite meaning. The rupturing strength of the normal atmosphere rests upon two factors only, (1) quantity of ionization produced by the rupturing voltage, (2) the distance between the electrodes. The rupturing gradient varies from 300 kv per inch (120 kv per centimeter) at lowest ionization to 3 kv per inch (1.2 kv per centimeter) at highest ionization with no indication that the limits at either end of this range have as yet been found.

In discussing the phenomena in oil, Professor Ryan stated that the failure of the oil as an insulator is due to ions liberated by the electric stress from the supply of free ions in the metals of the electrodes. The electric stress required to detach ions from metals to the oil is much lower than the corresponding stress for a gas. The further conclusion follows necessarily that a compressed gas must, in regard to *insulating quality alone*, be superior to oil.

In a communication from Mr. E. L. West, general manager of the Central Colorado Power Company, it was stated that the corona loss on the line of this company is much higher with the receiver load off than with it on. He found that with nothing whatever connected to the line a station voltage of 77 kv (effective sine wave) applied at Shoshone caused part-corona to start on the line conductors over the passes, and that as the voltage increased the corona loss increased with almost the same rapidity that it would if it had been started simultaneously over the entire 181 miles (291 km) of line and attained a value, due to corona alone, of 16 kw per mile (10 kw per kilometer) at a station e.m.f. at Shoshone of 105 kv.

Discussion.

Prof. M. I. Pupin expressed the opinion that the engineer who proposes to study the phenomena which accompany high-potential transmission cannot make progress without employing the ionization theory. He said that Professor Ryan had done wonderfully well in applying the theory to corona phenomena. Probably the average electrical engineer is not as familiar with the electron theory as he should be, and every effort should be made to familiarize engineers with this most useful tool.

Mr. Ralph D. Mershon called attention to the fact that the term "striking distance" was used by Professor Ryan to refer to the depth of a certain zone within which a limiting stress existed, rather than the arcing distance between needle points as ordinarily considered. He outlined a theory of stress accumulation based essentially on logarithmic functions which agreed satisfactorily with the relations reported by Professor Ryan from experimental observations.

Mr. G. Faccioli explained in detail the significance of results of corona observations reported by him and Mr. Moody in 1909. He attributed the discrepancies between the values observed under test and the values indicated by theoretical formulas to the presence of bodies in the immediate neighborhood of the electrodes and to the influence of the leads attached to the electrodes. He stated that the formation of corona is accelerated when a small piece of insulating material is placed on the surface of a cylindrical electrode. This condition is identical with that found in high-tension transmission lines where the line wires are attached to the insulators.

Dr. C. P. Steinmetz stated that the paper by Professor Ryan represents a correlation in convenient form of the vast amount of experience which has been collected since 1904, when the first classic paper of the kind was presented by Professor Ryan. Dr. Steinmetz said that the chief disadvantage of the ionic theory resides in the fact that many of the predictions based on it prove incorrect; afterward, however, the theory is so modified as to cover the facts discovered. Such results may appeal to the physicist who merely makes a correction in a curve or formula, but the engineer must be sure of his predeterminations before they are embodied in the construction of a transmission line. The breaking down of the air by the formation of corona requires not only a certain voltage gradient, but also a sufficient distance—that is, a certain total voltage. The fact that the electricity during discharge follows narrow channels of flow can be explained on the basis of the unstable conductivity of the dielectric. That is, the current tends immediately to increase along any narrow path where it may first form, due to the fact that the presence of the current itself increases the conductivity locally.

In a written communication to the discussion Prof. J. B. Whitehead discussed certain features of the ionic theory and presented evidence to show that the presence of a greater or less number of ions has no influence on the voltage at which corona starts. For example, absolutely no difference in the voltage at which corona starts is observed when the discharging wire is subjected to a copious supply of Roentgen rays, although the rays furnish one of the most powerful ionizing agents known.

Mr. Erich Housmann in a written communication called attention to the fact that the critical voltage at which energy loss begins varies almost exactly with the density of air, and hence in higher altitudes the critical voltage will be lower. The corona loss is proportional to the square of the excess voltage over the critical value. When the distant end of a transmission line is open-circuited the voltage at every point on the line increases, and when the potential over a considerable portion of the circuit exceeds the critical value a loss of energy ensues. In view of these facts it is possible for the con-

ditions to be such that an ammeter at the station may indicate approximately the same value of current when the distant end of a transmission line is open-circuited as when connected to the full load.

Prof. Samuel Sheldon attributed to the differences in the chemical constituents of air the fact that the behavior of air with reference to its increase in dielectric strength with increase in gas pressure is erratic, and reaches a turning point or "hump" at from 150 lb. to 200 lb. per square inch. The initiation of the hump probably accompanies the initial ionization of the nitrogen of the air.

In a written communication Mr. J. E. Noeggerath showed that the phenomena in mercury-vapor lamps serve to support the views of Professor Ryan relative to corona phenomena, especially that concerning the high voltage required to start the ions, the continuation of ionization at voltages lower than at starting, the starting of ionization at lower voltages when a supply of ions is present and high stresses near the electrodes with low-voltage gradient between them. A practical conclusion which may be derived from the last-mentioned phenomenon is that when the critical transmission voltage is reached an increase in e.m.f. involves either a large increase in the distance between wires or a reduction in the ratio between the maximum and the effective voltage—that is, the adoption of direct current for transmission.

Artificial Illumination and the Eye.

At a meeting of the New York Section of the Illuminating Engineering Society held on Jan. 12 three papers were read and discussed. Artificial illumination as a factor in the production of ocular discomfort was treated in a paper by Dr. Nelson M. Black, Milwaukee, Wis. Dr. Percy W. Cobb, physiologist of the National Electric Lamp Association, Cleveland, Ohio, presented a paper dealing with physiological points bearing on glare. Mr. Paul Bauder, of the National Electric Lamp Association, read a paper in which reflection coefficients were discussed in detail.

Dr. Black described fully the different parts of the eye, paying particular attention to the rods, the cones and the pigmentary layer. In the external segments of the rods is the light-sensitive pigment known as visual purple, which contains an unstable substance, readily decomposed by the mechanical or chemical effects of the ether waves. The rapidity of decomposition depends upon the color of the light and upon its intensity, while provision exists in the retina for the constant regeneration of the visual purple, the restoration process taking place rapidly in dim light or darkness.

The eye is able to adapt itself to an enormous range of intensity of illumination, but the length of time the eye may be used with comfort is greater with the weaker illumination. The sensation of glare is produced when, for example, a person passes quickly from a dark room to a brilliantly lighted one, on account of the time that must elapse before the visual apparatus properly adjusts itself to the light intensity to which the eye is subjected. In view of the fact that exposure of the unprotected eyes to the light having a spectrum including wave-lengths extending far into the ultra-violet produces serious and often lasting injuries, the violet and ultra-violet rays have been considered the cause of all eye troubles extant. However, by reason of the absorption of rays having wavelengths of less than 295 microns by the cornea and of less than 400 microns by the lens, practically no ultra-violet rays reach the retina, and hence the ill effects upon the eye are probably superficial. Moreover, the glass envelope used with most illuminants absorbs the ultra-violet rays, and therefore the eye is not usually subjected to even the superficial injury.

Dr. Black expressed the opinion that at least a part of the ocular discomfort observed from the use of the eyes under artificial light results from the irritating effect of the luminous or visible radiations of such illumination upon the unprotected retinal elements. The visual purple, which is an essential factor to vision and is the protective agent to the retinal elements against light, is used up by the improper application of illuminants having spectra with relatively more radiations which decompose this photochemic substance more rapidly than sunlight. This irritating effect is probably greater because insufficient time has elapsed for evolutionary changes to adapt the eye to modern artificial illumination.

Dr. Cobb, in his paper on glare, called attention to an important purely mathematical proposition, namely, that the image of any object seen against the face of a lens, prism or other refracting system is just as bright as the object from which it is formed. There is, it is true, always a small loss of light in passing through a layer of glass, but this is nearly constant about 10 per cent. The fact that an incandescent filament seen through a prismatic reflector appears to consist of innumerable filaments does not mean that the apparent candle-power per square inch, as far as the eye is concerned, is reduced. This quantity is reduced in such a case about as much as it would be in viewing the filament through a sheet of clear glass. That is, the eye is, in effect, looking at a filament a hundred times as large as the actual filament and (less by an insignificant fraction) exactly as bright in terms of candle-power per apparent square inch. Only when such reflectors are so far away that the eye is unable to distinguish their individual surfaces, and the media of the eye can themselves perform the necessary diffusion, is there any reduction in intrinsic brilliancy significant for the protection of the eyes. In the case of frosted or sand-blasted glass the individual refracting surfaces are very minute, the individual images very small, and diffusion is here complete even at close range.

Dr. Cobb claimed that scattered light in the eye from a side light-source is a large factor in reducing visual acuity and that there are probably two effects relative to the sensitiveness of the retina itself, one called forth by the extent of retinal surface stimulated by the side-light, and transient; the other the result of high intrinsic brilliancy of the side light-source and persistent (to a degree) after the side-light has ceased to act for a fraction of an hour. Obscuration of vision by scattered light in the eye of itself need be no more harmful to the eyes than looking out of a window into a fog. If, however, one can distinguish a definite change in the retinal state under side-illumination of the eye which may persist after the light is cut off, the possibility is not far to a practical application of this distinction. Although under practical conditions the actual reduction of visual acuity by this feature of glare is not so great as to cause in itself serious embarrassment of vision, yet it can be looked upon as a symptom by means of which the physiological diagnosis of a system of illumination may possibly be made in a scientific way, instead of the method of trying it out under actual conditions, so wasteful of time, capital and human eyesight.

Mr. Bauder gave much information relating to the reflection and absorption coefficients of various materials. In a certain room 10 ft. long, 10 ft. wide x 10 ft. high the following average values were found for the illumination obtained from various lamps as affected by the color of the walls—the ceiling and floor being white. The values are expressed in per cent, with 100 taken as the values obtained with white floor, walls and ceiling.

PERCENTAGE ILLUMINATION WITH DIFFERENT COLORS OF WALLS.

Lamps.	Red.	Green.	Blue.
3.1-watt carbon.....	53.39	48.57	43.90
2.5-watt carbon.....	50.85	49.35	44.55
2.0-watt tantalum.....	49.27	49.60	46.11
1.25-watt tungsten.....	47.20	51.08	50.38

As showing the extent to which the efficiency of a lighting equipment may be decreased by the use of improper globes,

the author presented the following table of absorption percentages with various styles of glass:

ABSORPTION BY DIFFERENT GLASSWARE.

	Per cent.
Clear glass	5–12
Light sand blast	10–20
Alabaster	10–20
Canary colored	15–20
Light blue alabaster	15–25
Heavy blue alabaster	15–30
Ribbed glass	15–30
Opaling glass	15–40
Ground glass	20–30
Medium opalescent	25–40
Heavy opalescent	30–60
Flame glass	30–60
Signal green	80–90
Ruby glass	85–90
Cobalt blue	90–95

Mr. Bauder stated that for certain locations it is desirable to direct the light at once, without wall or ceiling reflection, upon the work at hand, and in order to accomplish this result steel reflectors of various surface finishes have been adopted. A considerable loss occurs, as the efficiency of reflection varies from 60 to 65 according to the type of reflector but the results from a correct illumination standpoint are apparently warranted.

A great deal has been and is being done by incandescent lamp and reflector manufacturers to increase the lighting efficiencies of the various styles of reflector, and the possibilities for manufacturers of interior decorations, such as art glass, wall hangings, etc., include a field of immense dimensions.

Discussion.

Dr. J. E. Weeks remarked that the existence of visual purple has been acknowledged for some time. The destruction of the purple is accelerated under conditions of glare where the pupillary contraction cannot take place with sufficient rapidity. The most comfortable method of illuminating a room consists in hiding the source of light and illuminating merely the object which is to be viewed. Light from lamps at the side is particularly disagreeable. He expressed the opinion that the assembly rooms of the State Senate at Albany are very poorly lighted, largely on account of the fact that lamps are exposed directly to view along the side of the room.

Dr. H. H. Seabrook said that most of the damage to the visual organs is caused by the chemical rays. He called particular attention to the importance of considering not only the amount of light used in illuminating objects, but also the direction of the light.

Mr. W. H. Gardiner called attention to the fact that the trouble to the eyes known as cataract is quite prevalent in Labrador, where the eyes are frequently subjected to so-called snow blindness.

Mr. A. J. Sweet discussed in detail the factors upon which glare may be said to depend. There are two distinct phenomena to which the name glare may be applied. According to one of these, the glare is proportional to the discomfort produced, while according to the other the glare varies with the depression of visual function. The depression of perception varies with the amount of flux, while the comfort depends upon the specific brilliancy of the light source. Tests have shown that when the visual angle of separation between an external light and the object illuminated exceeds about 26 deg. the amount of flux obtained from the external source has no effect upon the ability to see the object viewed. This particular form of glare is quite independent of that to which ocular discomfort may be attributed.

Prof. S. W. Ashe stated that it is not proper to compare illuminants on the single basis of the amount of flux produced, but the effect of each illuminant on the visual acuity must be taken into consideration. Of lamps giving equal amounts of flux, that having a low specific brilliancy or placed beyond the range of direct view is far preferable to one having a high brilliancy and placed where it can easily be seen.

Mr. Norman Macbeth, in discussing the effect of different illuminants upon colored fabrics, stated that materials which seemed to match perfectly when illuminated by light from one source may appear quite different when viewed under light from a different source. Color selectivity depends not only upon the material, but also upon the chemical composition of the dyes used in coloring the material.

Mr. Bassett Jones, Jr., remarked that in many localities the amount of light flux produced is of relatively minor importance in comparison with other features of the illuminating equipment, such as the harmony of the fixtures with the architectural treatment of the room and the effect of the color of the light upon the decorations employed.

Mr. E. L. Elliott remarked that the facts mentioned by Mr. Jones are properly considered when it is remembered that there is an art of illumination as well as a science of illumination. Both of these must be combined and receive the proper weight before correct results can be obtained.

Messages of Governors to Legislatures.

Abstracts of the annual messages of a number of Governors to State Legislatures were published in these columns last week. The following additional excerpts of messages relate to the recommendations regarding public utilities:

GOVERNOR SPRY, OF UTAH.

Governor Spry repeated the recommendation made by him two years ago for the creation of a Public Utilities Commission.

GOVERNOR M'GOVERN, OF WISCONSIN.

Governor McGovern, of Wisconsin, stated that the stock and bond law enacted in 1907 has been so construed by the Supreme Court as to limit the scope of the inquiry which the Railroad Commission might institute where public service corporations desired to issue stock and bonds or other evidences of indebtedness, for money only, to an ascertainment of the legal capacity or competency of corporations to issue these securities. So construed, this law was of little value. It did not authorize the disclosure of important facts relating to past issues of securities which should be in possession of the commission before new issues were authorized. On the other hand, it might result in the issue of a large volume of corporate securities the validity of which the State would have to recognize in future litigation concerning rate regulation. The law should be amended without delay. Instead of permitting the corporations to determine the amount and character of the securities they wished to issue the Legislature should do this and prescribe the purposes which justified such issues, leaving to the commission authority to ascertain in any given case whether the proposed purposes were within the terms of the statute and whether the proposed issue in character and amount was reasonably required to accomplish such purposes.

Governor McGovern said that of all the plans for workingmen's compensation thus far put in operation the German system was the best. He suggested the enactment of a statute which would do in Wisconsin what the German law had accomplished.

Only about a half dozen States in the Union were as richly endowed with water-powers as Wisconsin. The utilization of the water-powers should be brought with the jurisdiction of the Railroad Commission, to be regulated and controlled in the interest of all the people, the same as other public utilities. It did not seem unfair or unreasonable to secure to the public a share in the advantages which came from the use of this natural resource. The compensation for water-power privileges should not, of course, be so large as to discourage development.

GOVERNOR HAY, OF WASHINGTON.

Governor Hay recommended the abolition of the Railroad Commission, the Tax Commission and the office of Insurance Commissioner and the creation of a Public Service Commission. The Public Service Commission would undertake the duties

now carried on by the Railroad Commission in reference to transportation, telegraph and telephone companies with the added powers of supervision and regulative control over light, power, gas, water and irrigation companies or corporations doing business in the State.

Washington must face the issue of State or federal control of natural resources. National conservation as advocated by its most ardent advocates was designed less to benefit the consumer of the products of those resources than as a new means of obtaining increased revenue for the national treasury. The extra tax represented in the federal royalty would fall upon the citizens of the localities where coal mines and water-power were developed. The State would be inexcusably derelict if it failed to protest against such a proposition and at the same time failed to make immediate provisions for exercising its own prerogatives in controlling, administering and preserving its natural resources.

Governor Hay commended to the serious consideration of the Legislature a draft of a bill on the subject of workingmen's compensation and hoped that favorable action at this session would result.

GOVERNOR WILSON, OF NEW JERSEY.

Governor Wilson urged the imperative obligation to effect such changes in the law of the State as would henceforth effectually prevent the abuse of the privileges of incorporation which had in recent years brought so much discredit upon the State. It would be necessary to regulate and restrict the issue of securities, to enforce regulations with regard to bona fide capital, examining very rigorously the basis of capitalization, and to prescribe methods by which the public should be safeguarded against fraud, deception, extortion and every abuse of its confidence.

While there was a Public Utilities Commission in New Jersey it had hardly more than the powers of inquiry and advice. It was understood by everybody who knew anything of the common interest that it must have complete regulative powers: the power to regulate rates; the power to learn and make public everything that should furnish a basis for the public judgment with regard to the soundness, the efficiency, the economy of the business; the power, in brief, to adjust such service at every point and in every respect, whether of equipment or changes or methods of financing or means of service, to the general interest of the communities affected. Such regulation, based on thorough and authoritative inquiry, would go far toward disclosing and establishing those debatable values upon which so many questions of taxation turned. Values could not be taxed fairly until they had been ascertained and established. The great matter of conservation seemed to Governor Wilson like a part of the same subject. There should be systematic compensation for injured workmen, which would give them their rights by automatic operation of law.

Massachusetts Commission News.

The Worcester Electric Light Company has appealed to the Massachusetts Gas and Electric Light Commission against the Board of Aldermen of the City of Worcester, which recently granted a franchise to Mr. A. S. Lowell, a prominent merchant, to transmit electricity across Foster Street for distribution in the immediate neighborhood of his power plant. The commission will give a hearing on the case in the near future.

The Railroad Commission gave a hearing on Jan. 12 upon the petition of the Selectmen of Attleboro for increased service and fare reductions by the inauguration of workingmen's tickets on the Interstate Consolidated Street Railway Company. President F. H. Dewey and General Manager Henry C. Page, of Worcester, appeared for the company, and submitted figures showing that the cars were not seriously overcrowded even in the morning and night rush hours when the maximum factory traffic was handled, and that two and three extra cars were often run to meet the demands for increased service. President Dewey discussed the fare situation at some length, and stated that if the company granted workingmen's tickets between 5 and 7 a. m. and 5 and 7 p. m. at a rate of 3.5 cents per ride, as requested by the petitioners, the loss would easily amount to $12,000 a year—a sum which the company could ill afford to spare in view of its moderate earnings of from 4 per cent to 5 per cent dividends and the requirements of maintenance. Mr. Dewey closed by stating that the existing facilities provide a ride of from eight to twelve miles on a 5-cent fare with a free transfer, which is unusually reasonable for a street railway serving such a territory. The commission took the case under advisement.

Wisconsin Commission News.

Governor McGovern has appointed Mr. David Harlowe, of Milwaukee, to be a member of the Wisconsin Railroad Commission in place of Prof. B. H. Meyer, who recently resigned to accept a place on the Interstate Commerce Commission at Washington. Mr. Harlowe is a railroad-rate expert by education and business training, being at present the traffic manager for the Allis-Chalmers Company, and one of the best-posted men on railroad matters in the State.

The Supreme Court has upheld the "indeterminate permit" feature of the public-utilities law. It was contended in the Kenosha case that a certificate of public convenience and necessity from the Rate Commission need not accompany a franchise secured from the City Council. One lighting company had surrendered its franchise and taken an indeterminate permit. Ten days later an electric railway company secured a lighting franchise from the Council, but made no application to the commission for a certificate of convenience and necessity. In quo warranto proceedings the lighting company prevented the railway company from carrying out the provisions of its franchise and the railway company appealed on the ground that the law was void.

The special committee appointed by the Legislature to consider the water-power question has completed its investigations and formulated its report. The bill which the majority members of the committee will file with the Governor will place the control of the water-powers with the Rate Commission. The terms of the bill provide that all future water-power franchises shall, under the terms of the act, come within the control of the commission, while franchises already given under legislative authority are to terminate within three years unless the holders of the franchise place their powers under the commission control. The franchises under the control of the commission are to be made indeterminate. The control of the commission in the case of new powers is to extend to the location of the dam from which the power is to be obtained. In case of existing water-powers where the full power is not now developed by existing power it is left with the commission to say whether new water-power sites on the stream can be utilized, and if so, where the dam shall be located. When water-power franchises come under its control, as the bill provides that the commission shall have the power to issue orders regulating the flowage, controlling the use of the power, and to decide practically all questions in regard to its operation. In cases of leases of the power, the control of the contract rates for its use is left with the commission.

The commission has authorized the Madison Gas & Electric Company to issue $727,000 par value of thirty-year gold bonds of the denomination of $1,000 each. These bonds are to bear interest at the rate of 6 per cent per annum, and the issue is to be under the terms of a mortgage or trust deed given to the Bankers' Trust Company, of New York. Of the issue, $400,000 is to be held for the purpose of acquiring by purchase or exchange or of paying or redeeming the first mortgage bonds, dated April 1, 1896, and now outstanding to the amount of $400,000, such exchange to be at par. Bonds to the value of $27,000 are to be used in exchange and liquidation, par for par, of an equal amount of outstanding obligations of the company now owing to the American Light & Traction Com-

pany and incurred by reason of extensions and additions made to the plant of the company. Bonds to the value of $100,000 are to be issued and sold for cash at not less than par value for the purpose of reimbursing the company for money actually expended for making extensions and additions to the property.

New York Commission News.

The Public Service Commission, Second District, has authorized the Corning Gas & Electric Company to exercise a franchise granted by the Village of Painted Post, Steuben County, for the purpose of furnishing electricity for light, heat and power. The East Hampton Electric Light Company has been authorized to issue $13,500 par value first mortgage 6 per cent bonds, the proceeds to be used for equipment and improvement of its plant and distributing system.

The Syracuse Rapid Transit Railway Company has been authorized to issue its preferred capital stock to the amount of $1,750,000, to be disposed of at not less than par and the proceeds to be used to pay and discharge the principal of promissory notes of the Syracuse Rapid Transit Company to the amount of $1,660,000. The remaining $90,000 is to be used for additions, extensions and betterments. The authorization is upon the express condition that the corporation shall credit to its fixed capital account the sum of $57,189, which the commission found charged to capital account, but not properly the subject of capitalization.

The Chasm Power Company, of Chateaugay, N. Y., was ordered to show cause before Jan. 16 why an order should not be made requiring the company to place its street-lighting and distributing system in a safe condition. Investigation by the commission of the company's plant followed a fatal accident recently to a telephone lineman, who came in contact with the wires of the company. The investigation disclosed that the method employed by the company of operating its street incandescent-lighting system was very poor, inasmuch as when the lights are cut out, the circuit at any lamp remains alive on account of a permanent connection at a distant end of the circuit. These wires, being constantly alive, afford a dangerous operating condition, which the commission seeks to remedy.

At a hearing before Commissioner Maltbie of the Public Service Commission of the First District of New York, Jan. 16, on the application of the Long Acre Light & Power Company for permission to issue $10,000,000 worth of stock and $50,000,000 of bonds, two points were settled by decision of the commission. The New York Edison Company, interposing, claimed that the Long Acre company had invalidated its franchise by non-operation. The attorneys of the Long Acre company made a motion that the New York Edison Company be prohibited from taking part in the hearings and also moved that all evidence as to the validity of the Long Acre franchise be stricken from the records. In the session of Jan. 16 Commissioner Maltbie decided both of these motions adversely to the Long Acre company. He said that it was the opinion of the commission that the New York Edison Company had a right to be heard and also he declared that the Long Acre company must produce evidence to show that its original franchise had not lapsed on account of failure to be exercised. With regard to the last motion, the attorneys for the Long Acre company asked time to prepare briefs and furnish evidence as to the validity of its franchise. The next hearing was therefore set for Jan. 31.

During the past week there were two hearings upon the complaint of consumers in the Far Rockaway section of New York against the rate charged by the Queens Borough Gas & Electric Company for electrical energy. The time at these hearings was occupied with the technical testimony of expert accountants and the engineers. The company claims that it is now charging as low a rate for energy as can be done and earn a fair return upon the money invested.

Maryland Public Service Commission News.

The Maryland Publice Service Commission last week filed with Governor Crothers its first report. The commission reports that its jurisdiction covers 220 corporations, with bond and stock issues aggregating $1,772,578,699. Reference is made to delays in organization, which was finally effected on June 1, when a full board, consisting of Mr. James M. Ambler (chairman), Mr. Philip H. Laird and Dr. Joshua W. Hering, met for the first time. Owing to a suit brought questioning the legality of the payment of salaries in excess of $3,000 to employees of the commission the State comptroller will not honor requisitions for amounts in excess of $3,000, and the engineering department cannot be organized unless better salaries are paid.

Three pending investigations are mentioned as involving great labor and study. One of these relates to rates for common carriers by water, filed by the Merchants and Manufacturers' Association; another to rates for telephone service, based on a schedule by the Chesapeake & Potomac Telephone Company, and the third to a complaint against the Consolidated Gas, Electric Light & Power Company relative to its charges for gas and electricity.

Referring to this latter, the commission says that on June 16, 1910, the commission was advised by the Mayor of Baltimore, through a gentleman connected with the city solicitor's office, that the complaint against the Consolidated Gas, Electric Light & Power Company, of Baltimore City, under section 36 of the Public Service Commission law, would be ready for filing by the first of July. The complaint has not yet been filed. The understanding is that it will be presented early in the present year. Because of its large fixed charges, the commission thought it advisable to reserve its funds as much as possible in order that money might be available for making physical valuations of corporate properties, if such course was deemed necessary.

Mr. Charles E. Phelps, chief engineer of the commission, has worked out a plan for the organization of his department. It provides for a transportation division, with a civil engineer in charge; an accident division, a testing division and a statistical division, with a superintendent in charge. Since the commission was organized eighty-four cases have been entered upon its regular docket and forty-nine upon its correspondent docket. Thirty-four of the regular cases have been decided after hearings, twenty-three have been settled either by withdrawal or by compliance on the part of the corporations, and twenty-four remain open. The commission found that it had no jurisdiction in three cases. Thirty-two of the correspondence cases were settled, thirteen remain open, and four were carried to the regular docket. The commission demands a uniform system of accounts as a necessary aid to it in its work.

The report states in conclusion that it is gratifying to the commission to record the fact that so far the great majority of the corporations of the State have met the commission in a friendly spirit. Changes and adjustments to new conditions will entail upon them extra work and some annoyance at the outset, but it is believed that in a short time the spirit of cooperation will prevail generally, with better and cheaper service for the public and reasonable and just profits for the corporations.

The commission has approved an application for the consolidation of the Park Heights and the Mortimer Heights Water Company. The new company is authorized to issue $100,000 worth of stock and $75,000 worth of 6 per cent bonds.

The Washington, Westminster & Gettysburg Railroad Company last week filed with the Public Service Commission an application to allow it to construct a railway from Brentwood, Md., passing through Prince George's, Montgomery, Howard, Frederick and Carroll Counties to the Pennsylvania line, and then to Gettysburg. In order to pay for the right-of-way and for the construction the company asks the approval of the commission to issue $100,000 of stock and in addition $35,000 of bonds and $6,000 of preferred stock at 6 per cent for each

mile constructed. The application will be heard on Jan. 25.

Mr. Philip D. Laird, a member of the Public Service Commission, was in Easton last week with the chief engineer to the commission, Mr. Charles E. Phelps, to investigate the Easton Light & Fuel Company. Complaints were filed against the price, quality and quantity of the company's gas and electricity by the people of Easton. The company denied the truth of the allegations and asked for an investigation. Throngs of people attended the hearings, which are still being continued, and much interest is being manifested by the residents as to the outcome of the complaints.

At a suggestion from the commission the Fire Board of Baltimore has ordered the removal of all gas gages from the engine and truck houses of Baltimore. They were placed in these places by Superintendent of Lamps and Lighting McCuen for the purpose of keeping record of the gas pressure in the different sections of the city. Mr. McCuen contends that these gages are absolutely necessary for the protection of the consumers, and manifested considerable surprise when the commission suggested their removal. Chief Engineer Phelps, of the commission, explained that the gages had been ordered removed by the commission on his recommendation. He said that in place of these gages, many of which have long been out of order and few of which were ever consulted, the commission proposes to keep one stationary gage at the City Hall and to use portable gages to test the pressure from time to time in other sections of the city.

Holding that a corporation has no right to abandon or refuse to place at the disposal of the public such utilities as it may have, which, if put into operation, would be for the public convenience, the commission last week handed down a decision in the case of the Old Frederick Road Improvement Association against the United Railways & Electric Companies, of Baltimore. The latter was ordered to establish satisfactory connections between the present terminus of its Catonsville line at Stoddards and its Ellicott City line at a point one-half mile away. The commission in passing on the matter pointed out the great inconvenience caused by the abandonment of the trackage. The commission was further asked to reduce the fare on the Ellicott City line and also order certain changes in the routing of the cars operated over it, but declined to do so on the ground that the facts set forth do not warrant such action. It, however, accepts the proposition of the company to grant walking transfers from eastbound Ellicott City cars to eastbound Towson cars. The establishment of transfer privileges between these two lines was one of the things asked for by the Improvement Association and the company voluntarily granted it.

Canadian Hydroelectric Commission News.

On Jan. 13 Hon. Adam Beck, chairman of the commission, announced that the loop connecting St. Mary's and London had been completed and power turned on. The completion of this section gives a double transmission circuit through all the municipalities north and west of Dundas and should obviate any further trouble in obtaining a continuous service. The line from Niagara Falls to Dundas has already a double circuit, so that the whole line from the Falls to St. Mary's, the present terminus of the commission's main line, is now equipped with a double circuit.

Georgia Hydroelectric Development.

Work has been begun on a hydroelectric system in north Georgia which ultimately will develop 155,000 hp. There are four sites, two on the Chattahoochee River, one on the Tullulah River and another on the Etowa River. The first to be developed is at Tullulah Falls, where a dam 384 ft. long and 112 ft. high is being constructed. About 60,000 hp is available here, and the power house will contain six 8000-kw turbines. Transmission to Atlanta, ninety miles distant, will be at 100,000 volts, to be reduced to 2300 volts for distribution.

CURRENT NEWS AND NOTES.

Interior Conduit in Colorado.—In Colorado during the six months ending Dec. 31, 1910, slightly over $60,000 worth of iron conduit was installed.

Lightning Rods in Germany.—Prussian regulations require that before lightning rods can be erected permission must be obtained from the local police authorities and the work must be inspected and approved. All lightning rods placed upon government buildings must be inspected by an expert electrician at least once a year to determine continuity of circuit and electrical ground resistance.

Mme. Curie and the French Institute.—Notwithstanding that the senior organization of the Institute of France—the forty immortals—has protested against the admittance of Mme. Curie to membership in the Académie des Sciences, the latter body has placed that distinguished scientific worker at the head of a list of six upon whom a vote will be taken on Jan. 23. Among the six are MM. Branley and Broca, known for their work in connection with wireless phenomena.

International Association of Municipal Electricians.—The *Proceedings* of the fifteenth annual convention of the International Association of Municipal Electricians held at Rochester, N. Y., Sept. 6 to 9, 1910, have been issued in book form. The association represents the municipal electrical departments of American and Canadian cities. Mr. H C. Bundy, of Watertown, N. Y., is president, and Mr. Clarence R. George, of Houston, Tex., is secretary. This year's convention will be held at St. Paul, Minn.

Wireless Consolidation in Germany.—According to a newspaper telegram the Marconi and Telefunken interests in Germany have been merged, thus putting an end to the competition and serious difficulties which have hitherto been caused by Marconi's refusal to co-operate with the Telefunken systems or to handle their messages. The trouble has been acute in respect to communcation between ships at sea and between ships and the shore, as the Hamburg-American and the North German Lloyd steamers are the only vessels of the German mercantile fleet that are equipped with the Marconi apparatus.

Terminal Electrification Agitation in Chicago.—The new president of the Illinois Central Railroad, Mr. Charles H. Markham, late of Pittsburgh, has entered upon the discharge of his duties, and one of the first things that confronted him in Chicago was the demand for the electrification of the Illinois Central Railroad terminal to help to abolish the smoke nuisance. Naturally, the new president was not able to give any definite assurances to the various petitioners that waited on him, but begged for time and promised to consider the problem with an unbiased mind. He must have been impressed, however, by the fact that there is a real public demand for the remedy of a long-standing grievance.

Electric Furnaces.—As has previously been noted in these columns, the Canadian government has for some years been investigating the subject of smelting iron ore by means of electricity and the latest result of this investigation has been recently published in a bulletin issued by the Department of Mines. When the investigation was first started in 1904 there were in existence but four electric furnaces for the smelting or handling of iron ore. In 1910 there were 114 furnaces, of which sixty-seven were in operation, eleven not working and thirty-six in course of erection. Of these furnaces thirty were in Germany, twenty-three in France, twelve in Italy, ten in Austria and ten in the United States. Seventy-seven of them were of the arc type, fifty-five were induction furnaces and two a combination of arc and resistance furnaces. A great increase in the output rating of the furnaces is noted, the largest at present in operation having a rated output of 15 metric tons per day.

Congress of Technology.—In order to celebrate the fiftieth anniversary of its establishment the Massachusetts Institute of Technology will hold a congress of technology on April 10 and 11, 1911.

Telephones Displace Telegraph on Canadian Pacific.—Because it insures greater safety and operates at higher efficiency, the Canadian Pacific Railway, which already has 2254 miles of single-track road equipped with telephones for train dispatching, will during the coming year install the telephone on another 2000 miles of road to replace the telegraph in the operation of trains.

Jovian Rejuvenation in New York.—A rejuvenation and dinner will be held by the Sons of Jove at Reisenweber's, Fifty-eighth Street and Eighth Avenue, New York, on Jan. 30. The dinner will take place at 6:30 and the rejuvenation at 8. Mr. George Weiderman, electrical contractor, New York, is the local Neptune; Mr. T. I. Jones, of the Brooklyn Edison Company, is Statesman, and Mr. J. F. Becker, of the United Electric Light & Power Company, is Assistant Statesman.

Wireless for Canadian Passenger Steamships.—A law recently enacted at Ottawa provides that every seagoing and coasting passenger ship of over 400 tons gross tonnage registered in Canada, and every seagoing and coasting freight ship having a gross tonnage of over 1200 tons, shall be equipped with apparatus for wireless telegraphy. Failure to comply with the law subjects the offending owner to a fine ranging from $100 to $1,000, or to a term of imprisonment not exceeding twelve months, or both.

Canadian Society of Civil Engineers.—The Canadian Society of Civil Engineers will meet at the Royal Alexandra Hotel, Winnipeg, Jan. 24 to 27. Mr. C. B. Smith, of the engineering firm of Smith, Kerry & Chace, of Toronto, will read a paper on the municipal electric light plant of Winnipeg, and a description of the Calgary Power Company's station now building at Horseshoe Falls on the Bow River, forty-five miles northwest of Calgary, in Alberta, Canada, a brief account of which appeared in the Dec. 29, 1910, issue, will also be given.

Central-Station Returns to Labor and Capital.—In a recent address Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, pointed out the interesting fact that the amount paid out yearly for labor by his company was just about equal to the wages of capital in the shape of bond interest and dividends on stock. He said that probably a similar proportion would be found to obtain in all companies supplying electricity. "In other words," said Mr. Insull, "the capitalist puts his money into the business and takes his pay in one-half of the profits, giving to labor the other half of the profits."

Niagara Power.—At a recent hearing in Washington on proposed legislation relating to the diversion of water at Niagara Falls, Gen. F. V. Greene advocated freedom of importation of Canadian water-power. Mr. Frederick L. Lovelace, secretary of the Niagara Falls Power Company, said his concern had been greatly injured by restrictions in the Burton law. He said his company would make no serious objection to open competition for the water of Niagara River. Mr. G. A. B. Scovell, of Lewiston, N. Y., believed in eliminating any restrictions on the obtaining of power from the Canadian side and pointed out that already all the power permitted to be used on this side is being utilized and that more than 100,000 hp is coming from two corporations on the Canadian shore.

Microphone Action in Lamp Filaments.—Noticing peculiar musical notes in an operator's head-set while certain supervisory switchboard lamps were lighted, Mr. William S. Paca, general manager of the Oil City (Pa.) telephone exchange, traced the source of the sounds to one of the cord lamps on the calling side. This lamp seemed to have a distinct microphonic action in picking up any sounds or vibrations of the desk position. In *Telephony*, Dec. 24, Mr. Paca describes his further experiments with this lamp, which seem to prove that ordinary loose contacts had no part in the microphone phenomenon, as the lamp had been in service a long time and was frequently handled. The needle of a galvanometer in series with the lamp swung in a way similar to the effect of a granulated carbon transmitter when agitated. When mounted on a transmitter diaphragm spoken words could be occasionally reproduced by the microphonic lamp. Mr. Paca concludes that the seat of the phenomenon is in the hydrocarbon paste of the filament itself. Several other switchboard lamps were found to share the effect.

Western Society of Engineers' Banquet.—The Western Society of Engineers held its forty-first annual meeting and dinner at the Red Room of the La Salle Hotel, Chicago, the evening of Jan. 11. The result of the election of officers for 1911 was announced as follows: President, Mr. O. P. Chamberlain; first vice-president, Mr. W. C. Armstrong; second vice-president, Mr. C. R. Dart; third vice-president, Prof. I. O. Baker; treasurer, Mr. Albert Reichmann; trustee, Mr. Ernest McCulloch. The secretary announced the membership at the close of 1910 to be 1124. Mr. R. H. Rice, of the board of supervising engineers, Chicago Traction, was awarded the Chanute medal for the best electrical engineering paper, on "Low-Tension Feeder Systems for Street Railways." Among the speakers of the evening was Prof. Charles E. Merriam, of the University of Chicago, one of Chicago's aldermen and chairman of the commission which for the past two years has been investigating city methods and expenditures. He brought out the importance of true engineering in conducting municipal affairs, as contrasted with political chicanery.

Colorado Electric Club.—The annual meeting of the Colorado Electric Club was held Thursday noon, Jan. 12, in connection with the weekly luncheon. Adjustable paper hats were distributed as favors and a florist presented each member with a carnation. A new Jovian beverage was served, and the lunch was a very successful affair, with music and toasts. Following the lunch the annual financial statement was given. The membership is now 308, and the average attendance during 1910 was ninety-four. Forty-three speakers entertained at weekly lunches last year. The present balance on hand in cash and other assets is $2,300. In appreciation of the unusual services of Mr. C. F. Oehlmann, the retiring secretary, who has done much toward organizing the club, he was presented through Mr. Greenwald as chairman, in behalf of the club, with a handsome Morris chair. Resolutions of sympathy were passed on the death of Senator Hughes, whose last public appearance was before the Electric Club. The meeting then proceeded to the election of eleven directors, as follows, who comprise also the chairmen of the various committees: Messrs. C. F. Oehlmann, illuminating engineer of the Denver Gas & Electric Company; J. F. Dostal, superintendent of electrical department of the Denver Gas & Electric Company; this year's Jupiter, H. T. Wolfenden, Denver representative of the Allis-Chalmers Company; J. F. Greenwald, publicity manager of the Colorado Telephone Company; B. S. Manuel, sales manager with the Westinghouse Electric & Manufacturing Company; W. Matthews, superintendent of overhead equipment with the Denver City Tramway; W. P. Carstarphen, president of the Carstarphen Electric Company; C. F. Stannard, secretary of the Denver Gas & Electric Company; Gen. Irving T. Hale, manager of the General Electric Company in Denver; W. F. Brown, of the Colorado Telephone Company, and J. F. Reardon, city electrician of Denver, for one-year term.

National Telephone Convention Postponed.—The National Independent Telephone Association announces that its annual convention, which is to be held in the Hotel La Salle, Chicago, has been postponed from Jan. 17-19 to Feb. 8-10.

Telephones in Winnipeg, Man.—During 1910 the number of telephones in the City of Winnipeg, Man., increased by 3437, making the total number of telephones there 16,161, which is said to mean a larger number per capita than in any other city in Canada. The telephone system is owned and operated by the government.

Missouri Electric, Gas, Street Railway and Water Works Association.—At a recent meeting of the executive committee of the Missouri Electric, Gas, Street Railway and Water Works Association in St. Louis it was arranged to hold the annual convention of the association in St. Louis on April 13, 14 and 15. Mr. R. J. Irvine, of Marshall, Mo., is president of the association.

C. E. A. Commercial Committee.—President Coate, of the Canadian Electrical Association, has appointed a commercial committee as suggested at the Muskoka convention of that body. The committee consists of: Mr. Eugene Creed, Toronto Electric Light Company, chairman; Mr. C. J. McNab, Montreal Light, Heat & Power Company; Mr. J. H. Larmouth, Electric Power Company, Belleville, Ont., and Mr. W. H. McIntyre, Ottawa Electric Company.

Boston Dinner of A. I. E. E.—The Boston Section of the American Institute of Electrical Engineers, in co-operation with the Boston Society of Civil Engineers and the American Society of Mechanical Engineers, will hold a dinner at Hotel Somerset, Boston, on Tuesday evening, Jan. 31. The guest of honor will be Prof. Elihu Thomson, past-president of the A. I. E. E. The object of the dinner is to facilitate arrangements for a joint engineering societies building in Boston.

Chicago Subway Project.—During the course of the telephone-rate investigation in Chicago Mr. B. E. Sunny, president of the Chicago Telephone Company, informed a committee of aldermen that Mr. B. J. Arnold, chief subway engineer of Chicago, would be ready to submit his report to the City Council about March 15. The building of the passenger subway in "downtown" streets will entail an additional expense on the telephone company for removing its underground circuits.

Proposed Revision of Electric-Light Rates in Chicago.—The chairman of the Aldermanic committee in charge of the matter declares that an investigation into the advisability of revising the rates of the Commonwealth Edison Company of Chicago should be begun in a few months. The present rate agreement with the city expires on July 12, 1912, and experience has shown that a year or more is not too long for an adequate investigation of the many aspects of rate schedules of public-utility corporations.

Employers' Liability in New Jersey.—It is reported that Senator Walter E. Edge will introduce in the New Jersey Legislature during the present week an employers' liability bill, prepared by the commission appointed by Governor Fort, and embodying various radical changes in the system of making compensation for personal injuries. Besides amending the present law, the bill will provide an elective compensation scheme to be put into operation by an agreement between employer and employee as a substitute for the right of recovery by action at law. In its modification of the present law the new measure would abolish contributory negligence as a defense for an action for personal injury, and would make wilful negligence only a defense. The bill defines wilful negligence as deliberate action or deliberate omission to act, operating as the approximate cause of injury, or conduct evincing reckless indifference to safety, or intoxication. The existing defense of assumption of risk on the part of an employee and fellow-servant is abolished. It is said that the schedule of compensation in the bill is more liberal than that allowed in any other state whose laws have a similar provision, in England or by the United States Steel Corporation, whose vice-president was one of the framers of the bill.

Medical Service by Wireless.—The captain of a freight steamer, the *Herman Frasch*, of New York, credits wireless telegraphy with saving his life. On Jan. 4 while at sea off Sabine Pass, Gulf of Mexico, Captain McGray was taken ill after eating canned salmon and his condition soon became critical. There being no doctor aboard, a wireless message was sent at random describing the symptoms and asking for medical advice. Shortly after a reply was received from the surgeon of the Ward steamer *Yucatan*, then in the harbor of Progreso, Yucatan, 800 miles distant, giving a prescription and details of treatment. The instructions thus received were followed and Captain McGray recovered.

Street-Lighting Controversy in Jersey City.—For some time there has been a controversy between the Street and Water Board of Jersey City, N. J., and the Public Service Electric Corporation on the subject of the substitution of 4-amp luminous arcs for 9.6-amp open arcs for street lighting. The city claims that the 4-amp luminous arc is not the equivalent of the 9.6-amp open arc, and has refused to pay the bills rendered since the substitution of the new lamp. Up to the present bills aggregating about $50,000 are held up. The claim has been made that instead of charging $75 per lamp per year, which is the price for lighting with the open-arc light, only $43.50 per lamp per year should be paid for lighting with the luminous arc.

Chicago Section of American Electrochemical Society.—The Chicago Section of the American Electrochemical Society will hold a meeting on the evening of Jan. 20 at the rooms of the Western Society of Engineers, devoted to a consideration of methods of treating iron and steel by the electric furnace. There will be four speakers. Mr. James Lyman, of the General Electric Company, will discuss *Electric Furnaces for the Manufacture of Iron and Steel.* He will be followed by Mr. F. T. Snyder, of the Metallurgical Engineering Company, on *Reliability of Electric Furnaces for Commercial Work.* Prof. C. F. Burgess, of the University of Wisconsin, on *Electrolytic Refining as a Step in the Production of Steel,* and Mr. Charles G. Osborne, of the Illinois Steel Company, on *Some Experiences with the Electric Furnace at South Chicago.* Members of the American Chemical Society and other engineers will be the guests of the local society for the evening.

Overhead Line Construction.—The overhead line construction committee of the National Electric Light Association, acting in co-operation with committees of the Maintenance of Way Association, the American Street and Interurban Railway Association and the American Institute of Electrical Engineers and a representative of the American Telephone & Telegraph Company, has prepared for general acceptance a set of specifications for overhead work. The specifications apply to overhead electric light and trolley line crossings (except trolley contact) over railroad rights-of-way, and the tracks and lines of wires situated thereon, and also to overhead electric lighting and transmission wires of over 5000 volts constant potential crossing or constructed over telephone, telegraph or other similar lines. The committee, of which Mr. Farley Osgood, of the Public Service Corporation, Newark, N. J., is chairman, has requested that all persons interested in such specifications communicate to the chairman any suggestions that they may care to make.

ELECTRICITY FROM A DRAINAGE CANAL—II.

Transmission Line, Terminal Station, Substations and Distribution System of the Sanitary District of Chicago.

THE main transmission line of the Sanitary District of Chicago follows the east bank of the Drainage Canal from the generating station, a mile and a half below Lockport, to the Western Avenue terminal station, thirty miles away, where the transmission potential of 44,000 volts is stepped down to the city distribution pressure of 12,000 volts.

As first constructed, the transmission line comprised two circuits of nineteen-strand aluminum conductor, equivalent in carrying capacity to No. 000 copper. These circuits were carried upon 50,000-volt Locke petticoat-type insulators mounted on steel poles or towers especially designed by the Sanitary District's engineers for this installation and built by the Aeromotor Company, Chicago. These poles are of bridge construction, measure 60 ft. over all, and are set 6 ft. into concrete, which is rounded above the surface of the surrounding ground to provide run-off for any water that may collect at the base. The lower cross-arm, also of steel lattice-work construction, measures 18 ft. across and the upper cross-arm 12 ft. When first erected the two circuits were installed in the usual manner on these cross-arms, and a ground wire, clamped at the peak of each pole, was carried throughout the length of the line.

In order to secure additional carrying capacity for the increasing load of the Sanitary District's plant the original arrangement of the transmission wires on the poles has been modified by the addition of two suspension-type insulators hung from the lower cross-arm at points midway between the original petticoat-insulator pins. Mounting an additional petticoat-type insulator at the peak of the poles will thus make available nine insulated wires, or three separate circuits. The last wire, taking the position of the original ground wire, is now being strung. During the past summer, however, the transmission line has been operated with the pole-peak ground wire in position and with the original line wire on each side of the upper cross-arm grounded at every fourth tower. This arrangement was undertaken as an experiment to substantiate the claims of those who advocate the use of ground wires and claim that sufficient protection above the line conductors will actually prevent lightning disturbances. Although the past summer was not so noteworthy for electrical storms as were several preceding seasons, when great difficulty was experienced in keeping the lines in operation, especially satisfactory results have been obtained from the protected circuit, only three "minimum" or two-minute outages having occurred during the lightning season. The circuit on the south side of the pole line, formed by the lines carried on the two petticoat and one suspension insulator on the lower arm, has been equipped with the Nicholson type of grounded-ring protection, and the experience with this construction during the past season has duplicated that in New York State in showing a great reduction in the number of insulators broken.

Fig. 1—Interior of Western Avenue Terminal Station.

At each of the numerous railroad crossings the petticoat insulators are replaced by strain insulators in each direction, employing also suspension-type and pin insulators at each such junction to hold the junmper rigid. The steel towers are erected to 350-ft. intervals, and throughout eighteen miles of the line were set in holes blasted in the solid rock and afterward filled with concrete. The vertical shafts of these towers measure 42 in. square at the base and 14 in. at the top, and each tower complete weighs 4000 lb.

Following the line of transmission, an underground four-conductor telephone cable has been laid between the terminal station and the Lockport power house, providing two separate telephone circuits between these stations for use in dispatching. At half-mile intervals these telephone circuits are brought up to junction boxes at the surface of the ground, where the line patrolmen, or troublemen, can obtain communication with the dis-

patcher or the generating station by inserting the plug of the lineman's telephone set which is carried as part of the equipment. This telephone line is, of course, entirely free from noise or inductive effects of any kind, and is extremely useful during construction work or times of line trouble. All trouble calls on the transmission line are handled from the Western Avenue station, where two shifts of troublemen are maintained who are provided with high-speed motor boats for quickly reaching the scene of the interruption.

WESTERN AVENUE TERMINAL STATION.

The Western Avenue terminal station of the Sanitary District's transmisison line, where the incoming 44,000-volt energy is reduced to a pressure of 12,000 volts for distribution within the city limits, is located on the south bank of the Drainage Canal near the Western Avenue bridge. The building is an attractively designed structure of concrete blocks with red tile roof. In floor plan it measures 124 ft. long and 70 ft. wide, and it is 42 ft. to the eaves of the roof. Besides housing the step-down transformers this station contains the distributing equip-

Fig. 2—Map Showing Transmission Lines and Substations.

ment for the 12,000-volt circuits and a 2300-volt substation for supplying energy for lamps and motors to neighboring consumers.

From towers equipped with strain insulators for taking up the dead-end pull of the transmission line the 44,000-volt wires are led into the station through hooded entries at the second floor or gallery level. At this point provision is made, by an arrangement of cross-connecting switches, for quickly utilizing as a transmission delta any three of the six completed conductors which may remain unaffected in case of trouble. Taps from the high-tension buses lead through the concrete floor of the gallery to the 44,000-volt General Electric aluminum-cell lightning arresters. After traversing the choke coils the station energy is led through type H General Electric transformer switches and through series transformers operating the trip relays on these switches. Six banks, 4000 kw each, of General Electric oil-insulated, water-cooled transformers have already been installed in the Western Avenue station for handling the three transmission circuits, the third of which is about completed. Two 4000-kw banks are thus provided for each circuit, and the high-tension buses are further equipped with General Electric type H motor-operated oil switches for tying together the high-tension sides of adjacent pairs of transformers. This arrangement is also duplicated in both the main and transfer buses on the low-tension side of the transformers. All of the 44,000-volt conductors in the station, which are carried on the insulators mounted on pipe construction, are painted red as a danger warning to workmen.

The 12,000-volt leads from the transformer banks are taken to the hinge terminals of double-knife, double-throw disconnecting switches, made by the Delta-Star Electric Company. The upper terminals of these switches communicate with the main station buses through type H General Electric motor-controlled oil switches, and from these main buses, through type E Westinghouse solenoid-controlled oil switches and thence through double-knife, double-throw disconnecting switches similar to those above described, with the respective outgoing commercial circuits. The lower clips of the transformer-bank, double-knife, double-throw switches are connected through Hartman electrically-operated oil switches to the transfer bus, and thence through another group of Hartman hand-operated switches to the lower clips of the feeder line double-knife switches. This arrangement of the double-knife, double-pole switches makes it possible to transfer a circuit from the main to the transfer bus, or vice versa, without interrupting the flow of energy to the feeder. The sectionalizing switches in the main 12,000-volt buses, like those in the 44,000-volt buses, are General Electric type H, equipped with time-limit relays.

There are twenty outgoing circuits, each feeding separate parts of the city, to which energy is transmitted by the Sanitary District.

For measuring the energy used by the city an ingenious modification has been made in the main 12,000-volt station buses. Throughout part of their length two of the phases of these buses are formed of duplicate copper sections, separated from each other by 1 in. or more of fiber insulation, but connected together through the primary winding of a 600-amp series transformer. The transformer-bank buses feed into the upper conductors of these buses, while the city service is taken off the lower conductors; thus the energy required by the city traverses the series transformer winding. In circuit with the secondary of this transformer are connected a Westinghouse graphic recording wattmeter for securing a diagram of the demand curve of the city service and a watt-hour meter for totalizing the energy consumed.

The control of the transformer switches on both the 44,000-volt and the 12,000-volt sides is centered in a benchboard located on the operating gallery at the south end of the station. This board is arranged with ammeters and power-factor meters, indicating the condition of the transmission circuits, and also with totalizing watt-hour meters for measuring the aggregate energy transmitted. The low-tension switchboard for controlling the distribution feeder circuits comprises ten panels with two circuits to each panel. Indicating wattmeters and power-factor meters are provided, and connections are arranged to meter buses back of the board by which a Westinghouse graphic recording wattmeter and a General Electric recording voltmeter can be applied to measure the power or voltage of any circuit.

As before explained, six banks of three step-down transformers have already been installed in the Western Avenue terminal station. The complete plans call for the installation of eight such banks, the last of which will be added when the additional transmission circuit is completed on the second pole line, which will later be erected, connecting the substation with the generating power house at Lockport.

At the north end of the Western Avenue station an 1800-kw bank of oil-insulated, water-cooled transformers, stepping down from 12,000 volts to 2300 volts, has been provided for supplying energy for the motor and lamp requirements of adjacent customers. Also at this end of the building are two centrifugal pumps for furnishing cooling water for transformers and two motor-generator sets for furnishing direct current for station lighting and oil-switch operation. These pumps

and direct-current generators are direct-connected to 440-volt, three-phase induction motors. There is also being installed in the north end of the station a 200-kw synchronous motor-generator set, delivering direct current at 550 volts. The primary purpose of this set is the operation of a large motor-driven eight-track rolling-lift bridge about 500 ft. distant. This interesting bridge was described in the *Electrical World* of April 14, 1910. But as there is little or no navigation

Fig. 3—Reconstructed Insulator Arrangement for Three Transmission Circuits.

on this portion of the Drainage Canal the bridge will likely be seldom operated for a number of years to come. However, running idle, the motor-generator set will perform an important service in the station by taking a leading current with its fields over-excited, thus partly offsetting the lagging-current demand of the large industrial service supplied by the Sanitary District and so increasing the efficiency of the transmission line.

Just north of the terminal station, on the canal bank, is a low concrete building, 10 ft. x 50 ft., which houses the sixty-cell battery which supplies energy for actuating the remote-controlled switches in the station. This battery is controlled from a panel on the small switchboard from which the transformer cooling-water pumps and the motor-generator sets are manipulated. A 20-ton electric traveling crane built by the Case Manufacturing Company spans the station over the transformers.

DISTRIBUTION OF HYDROELECTRIC ENERGY.

From the Western Avenue terminal station, where the transmitted potential of 44,000 volts is reduced to 12,000 volts for transmission within the city limits, twenty 12,000-volt circuits are led out on underground and overhead lines to the various substations belonging to the Sanitary District, the City of Chicago and several large consumers who purchase 12,000-volt energy directly.

The substations owned and operated by the Sanitary District of Chicago at which the incoming 12,000-volt energy is again stepped down to 2300 volts for local distribution, together with the present connected loads they serve, are as follows:

Ashland Avenue and Thirty-sixth Street, 2560 kw; Kinzie Street and Austin Avenue, 611 kw; Leavitt Street and Fullerton Avenue, 1097 kw; Twelfth Street and Forty-seventh Avenue, 1740 kw; Western Avenue and Canal, 2540 kw.

The last-named station is contained within the terminal station itself, and is referred to in preceding paragraphs. The construction of the other 12,000-2300-volt substations is in general nearly uniform, following the standard exemplified in the Ashland Avenue substation, exterior and interior views of which are reproduced herewith. The exterior of this one-story structure is of yellow pressed brick and the interior is lined with white enameled brick, a partition of the same material extending along one side of the room and inclosing the high-tension bus compartments and oil switches. This station contains a bank of three 200-kw oil-insulated, self-cooling transformers for reducing the city transmission pressure of 12,000 volts to the local distribution pressure, 2300 volts. The oil switches for both 12,000-volt and 2300-volt circuits are hand-operated.

In addition to the Sanitary District substations above noted Drainage Canal hydroelectric energy is also supplied to the Halsted Street, Wood Street, Rice & Lincoln, H. N. May, Emerald Avenue, Wentworth Avenue and R. A. Waller street-lighting plants of the City of Chicago; to the constant-current transformer arc-lighting substations in Humboldt, Douglass, Garfield and Lincoln Parks, Chicago, and to the substations in the neighboring villages of Cicero, Berwyn, Blue Island, Dolton, Morgan Park and Lyons.

As the Sanitary District of Chicago is a public body, organized and supported by the taxpayers who compose the population of the City of Chicago and an outlying fringe of territory, the trustees of its board have naturally taken the view that its electrical output should so far as possible be utilized for the public benefit of this population, and large use has accordingly been made of this energy for municipal lighting and pumping purposes. It was the hope of Mr. R. R. McCormick, former president of the Sanitary District, that at some time in the future not only should all the city lighting in Chicago be furnished by the Lockport plant during hours of darkness, but that by day the same source should be used to pump the city's water supply. Of course, when the system was first put into operation municipal needs were not at once equal to the output of the plant, so the Sanitary District officials had to choose between the three possible courses of (1) allowing large blocks of generating capacity to rest idle during many hours of the day; (2) selling energy to an outside distributing company at a low figure from which a small return would be realized on the public's investment, or (3) organizing a sales department for aggressively undertaking the distribution of its output to commercial consumers. The last-named plan was followed, and the Sanitary District board secured the services of an experienced

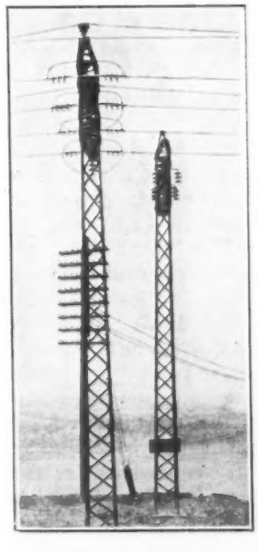


Fig. 4—Strain Tower at Railroad Crossing.

sales engineer and began acquiring commercial load, which in three years has grown to a total connected value of nearly 20,000 hp in lamps and motors. The total municipal load is meanwhile 13,357 hp.

There are now 204 commercial consumers in Chicago. Some of the largest of these are the McCormick works of the International Harvester Company, with a connected load of 1985 hp in motors; the Simonds Manufacturing Company, 1263 hp;

Forest Park Amusement Company, 1200 hp; Chicago Reduction Company, garbage destructors, 675 hp (twenty-four-hour load); Liquid Carbonic Company, 600 hp; Aermotor Company, 600 hp; Marsh & Bingham, 500 hp; American Spiral Pipe Company, 461 hp; L. Wolf Manufacturing Company, 362 hp. Other large consumers outside of the city limits are the Joliet works of the Illinois Steel Company, with a connected load of 2620 hp in motors; the United States Crushed Stone Company,

Fig. 5—Typical Distributing Substation.

McCook, Ill., 1800 hp, and the Illinois State Penitentiary at Joliet, 705 hp. The Joliet load is furnished directly from the generating-station 6600-volt buses. The steel company's demand continues throughout the twenty-four hours of the day.

The rates for industrial motor service are based on a maximum-demand system, the customer's demand being measured by a Wright demand meter or estimated by multiplying his total connected horse-power in motors by the following percentage factors:

Under 10 hp, one motor only, 85 per cent; under 10 hp, more than one motor, 75 per cent; 10 hp to 50 hp, 65 per cent; over 50 hp, 55 per cent.

For the first thirty hours' use of the maximum, as above determined, the charge is 9 cents per kw-hour.

For the second thirty hours' use of maximum, 4 cents per kw-hour.

For all over the first sixty hours' use of maximum, 2½ cents per kw-hour.

Where the 4-cent and 2½-cent portions of bills aggregate or exceed $50 prompt-payment discounts are allowed on this part, ranging from 10 per cent for $50 and 40 per cent for $300 to 60 per cent for $1,000.

In the villages of Blue Island, Berwyn and Lockport the Sanitary District has taken over the existing distribution systems and serves residence and business customers with lighting and motor service. The district has 537 consumers in Blue Island, 203 in Berwyn and 196 in Lockport. All of these consumers use electricity through meters, which are read monthly by the district's representative and bills rendered from the Chicago office in the American Trust Building. For this class of service a rate of 10 cents per kw-hour is charged for the first twenty kw-hours used, 7 cents per kw-hour for the next 100 kw-hours and 6 cents per kw-hour for all used thereafter. The minimum bill is $1 for each residence or store. Should payment of his bill be delayed, after ten days from its date the consumer is held liable for the consumption rendered at 11 cents per kw-hour for lighting and 7 cents per kw-hour for motors. The regular rate for energy for motors when registered by a separate meter is 6 cents per kw-hour, with a monthly minimum of $1 per horse-power. Residents of Dolton are served with Drainage Canal energy at a flat rate by the local municipality, which purchases its supply from the Sanitary District.

As before noted, the sale of electrical energy to municipalities for public use is one of the most logical and increasingly important aspects of the Sanitary District's electrical department. Electric pumping is already done in a number of nearby places with Drainage Canal power, and installations of very large sewage pumping and flushing units are now being erected. Through the new North or Evanston Channel connecting with the North Branch of the Chicago River, a rinsing flow of 40,000 cu. ft. of lake water per minute will be produced by four 150-hp motor-driven horizontal screw pumps at Wilmette, lifting the water 3 ft. above lake level to provide the flowage head for discharging through the nine miles of 720-sq. ft. section canal. The 440-volt, three-phase, 60-cycle motors will be energized over a 12,000-volt transmission line from the Western Avenue terminal station. Since this energy will be supplied in part by the fall at Lockport of the water pumped at Wilmette, a curious closed circuit of electrical and hydraulic power will be presented when the pumping station is in operation. A 750-hp motor is also being installed as an experiment to replace one of the engine-driven pumps in the Thirty-ninth Street sewage pumping station, which delivers through the Thirty-ninth Street conduit the contents of the intercepting lake-shore sewer which collects the flow of the various street drains that formerly emptied into the lake along the south shore.

The District is supplying energy for water-works pumping purposes at Lockport, Dolton (40 hp), Blue Island (200 hp) and Morgan Park (120 hp), besides operating the sprinkling pumps at Lincoln Park, in Chicago, where 375 hp in centrifugal pumps is installed. For this twenty-four-hour service to municipalities the Sanitary District receives $26.40 per hp-year.

The rate for twelve-hour lighting service is $15 per hp-year to municipalities. Besides the park and street lighting in Chicago, the District lights Cicero, Berwyn, Blue Island, Dolton, Morgan Park and Lyons. In Chicago the District has taken over the operation of the city's thirteen generating stations and substations for its street-lighting system, and is replacing the former engine-driven constant-current arc-lamp generators by motor-driven sets; also installing regulator-type transformers for energizing additional lamps. Along with this transfer of the city's plant properties goes the operation of its transmission and distribution circuits, which thus become available for use by the Sanitary District in serving its commercial motor-service customers during daylight hours if necessary. This agreement for joint use of lines will be the means of saving much expensive construction, which in the past has been necessarily duplicated by the two publicly owned systems.

One of the most important results of Sanitary District energy for municipal lighting in Chicago will be the addition of 10,000 arc lamps to the city's existing equipment of 12,200 lamps. The city has long been desirous of making its lighting facilities

Fig. 6—Interior at Ashland Avenue Substation.

more nearly adequate, but is near the constitutional limit of its bonded indebtedness. Under the new agreement with the Sanitary District the latter will furnish and install the additional 10,000 450-watt lamps, posts, conduits, etc., complete, with additional substations, for which outlay the city will repay the district in equal annual instalments, with interest, ending in 1918. The 10,000 new lamps are to be located at the rate of 500 a month. Fifty lamps will be installed on each circuit,

thirty to sixty circuits being supplied from a substation. Under the agreement the city will pay at the rate of $15 per hp-year for the energy to operate the 22,000 lamps, taken during an average period of eleven hours per day, ranging from eight and one-half hours in summer to fourteen hours in winter. The new City Hall and County Building, representing a connected load of 30,000 16-cp lamps and 2500 hp in motors, will use Drainage Canal energy. The substation in the basement

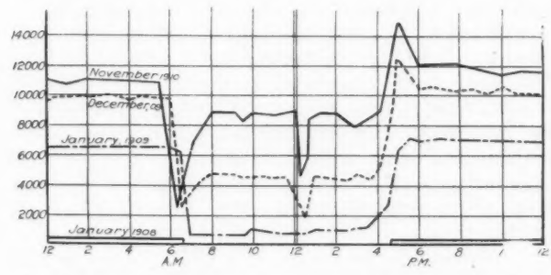


Fig. 7—Daily Load Curve for Three Years of Operation.

will contain a 4000-amp. 250-volt storage battery capable of carrying the entire electrical load of the buildings in case of interruption to the transmission system.

Besides its ninety miles of 44,000-volt circuits erected on thirty miles of steel towers the electrical department of the district operates 100 miles of single-circuit, 12,000-volt overhead lines, twenty-five miles of 12,000-volt underground circuit, twenty miles of 4000-2300-volt overhead lines and seven miles of 4000-2300-volt underground circuits. As indicative of the increasing electrical service of the Sanitary District to the community the following table shows the growth of the connected load by six-month periods:

	June 30, 1909.	Dec. 31, 1909	June 30, 1910.
Municipal	11,950 hp	12,673	12,966
Commercial	12,698 hp	14,773	22,872

The affairs of the Sanitary District are controlled by a board of nine trustees elected by the people, three being chosen each year. The present president of the board is Mr. Thomas A. Smyth, recently elected. The electrical development has been carried out, however, during the presidency of Mr. Robert R. McCormick, who took a marked and intelligent interest in it. Mr. George M. Wisner is chief engineer of the Sanitary District and Mr. Edward B. Ellicott is electrical engineer. Mr. Ellicott is entitled to commendation for the ability and zeal he has displayed in designing and conducting the electrical work of the district in the face of numerous difficulties.

NOTE ON THE OSCILLATION TRANSFORMER.

By John Stone Stone.

IN the evolution of wireless telegraphy a large variety of oscillation transformers have come into use, while the theory of only one form of them, the oldest and best known form, has been exhaustively studied. This particular form of the oscillation transformer consists of two oscillation circuits in mutual inductive relation to one another, as shown in Fig. 1. In what follows it will be shown that the theory of this particular oscillation transformer is the key to that of a number of other forms of oscillation transformers in which the two oscillation circuits are coupled together not merely by mutual inductance, but by having a common branch. It will be assumed that the resistance of the common branch is negligible compared to its reactance, this being a condition always realized in such transformers, as the principal dissipation of energy always takes place in the oscillation circuits at points outside the coils of the transformer *per se*.

In the oscillation transformer of Fig. 1 let the resistance, inductance and capacity of the first circuit be R_1, L_1 and C_1 respectively, while the corresponding constants of the second circuit are R_2, L_2 and C_2 respectively, and let M_{12} be the mutual inductance between the two circuits. The circuital equations will then be:

$$\left(\frac{d}{dt}+2\alpha_1+p_1^2\int(\ )\,dt\right)i_1 \pm \mu_1\frac{d}{dt}i_2=0$$

$$\left(\frac{d}{dt}+2\alpha_2+p_2^2\int(\ )\,dt\right)i_2 \pm \mu_2\frac{d}{dt}i_1=0$$

where i_1 and i_2 are the currents in the first and second circuits, respectively, and where

$$2\alpha_1=\frac{R_1}{L_1},\qquad p_1^2=\frac{1}{C_1L_1},\qquad \mu_1=\frac{M_{12}}{L_1}$$

$$2\alpha_2=\frac{R_2}{L_2},\qquad p_2^2=\frac{1}{C_2L_2},\qquad \mu_2=\frac{M_{12}}{L_2}$$

In the case of the transformer of Fig. 2 let R_1, L_1 and C_1 be the resistance, inductance and capacity, respectively, of the

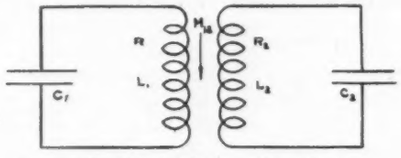


Fig. 1—Simple Oscillation Transformer.

first branch; let R_2, L_2 and C_2 be the corresponding constants of the second branch; let L be the inductance of the common branch; let M_1 be the mutual inductance between the common and the first branch; let M_2 be the mutual inductance between

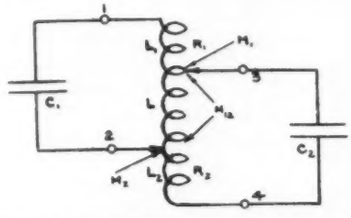


Fig. 2—General Oscillation Transformer.

the common and the second branch and let M_{12} be the mutual inductance between the first and second branches. The circuital equations will be

$$\left(\frac{d}{dt}+\frac{R_1}{L_1}+\frac{1}{C_1L_1}\int(\ )\,dt\right)i_1+\frac{L+M_1}{L_1}\frac{d}{dt}i-\frac{M_{12}}{L_1}\frac{d}{dt}i_2=0$$

$$\left(\frac{d}{dt}+\frac{R_2}{L_2}+\frac{1}{C_2L_2}\int(\ )\,dt\right)i_2-\frac{L+M_2}{L_2}\frac{d}{dt}i-\frac{M_{12}}{L_2}\frac{d}{dt}i_1=0$$

and

$$i_1=i+i_2$$

which give

$$\left(\frac{d}{dt}+\frac{R_1}{L_1+L+M_1}+\frac{1}{C_1(L_1+L+M_1)}\int(\ )\,dt\right)i_1-\frac{M_{12}+L+M_1}{L_2+L+M_2}\frac{d}{dt}i_1=0$$

and

$$\left(\frac{d}{dt}+\frac{R_2}{L_2+L+M_2}+\frac{1}{C_2(L_2+L+M_2)}\int(\ )\,dt\right)i_2-\frac{M_{12}+L+M_2}{L_2+L+M_2}\frac{d}{dt}i_1=0$$

Comparing these expressions with the corresponding expressions for the oscillation transformer of Fig. 1 it is evident

that the oscillation transformer of Fig. 2 is the equivalent of an oscillation transformer of the form shown in Fig. 1 in which the constants are such that

$$2\alpha_1 = \frac{R_1}{L_1 + L + M_1}$$

$$2\alpha_2 = \frac{R_2}{L_2 + L + M_2}$$

$$p_1^2 = \frac{1}{C_1 (L_1 + L + M_1)}$$

$$p_2^2 = \frac{1}{C_2 (L_2 + L + M_2)}$$

$$\mu_1 = \frac{M_{12} + L + M_1}{L_1 + L + M_1}$$

$$\mu_2 = \frac{M_{12} + L + M_2}{L_2 + L + M_2}$$

This correspondence not only makes all the work which has been done on the subject of the theory of the well-known oscillation transformer of Fig. 1 applicable to oscillation transformers of the type shown in Fig. 2 and available for predicating and interpreting the performance of such transformers, but it also makes such work available in the case of the transformers shown in Figs. 3, 4, 5 and 6, all of which, as well as that of Fig. 7, are but special forms of the transformer of Fig. 2.

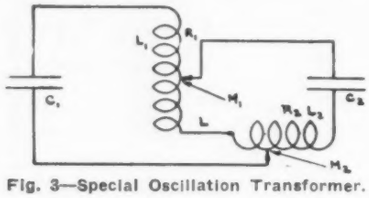


Fig. 3—Special Oscillation Transformer.

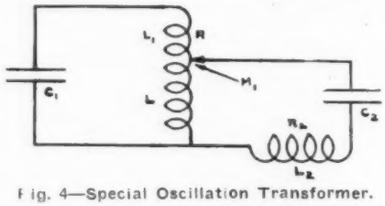


Fig. 4—Special Oscillation Transformer.

The case of Fig. 3 is obtained from that of Fig. 2 by the suppression of the mutual inductance between the first and second branches.

The case of Fig. 4 is obtained by the suppression of the mutual inductance between the first and second branch and also that between the second and the common branch.

The case of Fig. 5 is obtained by suppressing all of the mutual inductances.

The case of Fig. 6 is obtained by the suppression of the mutual inductances between the common branch and each of the other branches.

Finally, the case of Fig. 7, which is the same as that of Fig. 1, is obtained by the suppression of the common branch.

The most important mathematical function in connection with an oscillation transformer is its coupling coefficient, which may now be defined as

$$\sqrt{\mu_1 \mu_2} = \sqrt{\frac{(M_{12} + L + M_1)\ (M_{12} + L + M_2)}{(L_1 + L + M_1)\ (L_2 + L + M_2)}}$$

In the case of the oscillation transformer of Fig. 1 this coefficient reduces to the familiar function

$$\frac{M_{12}}{\sqrt{L_1 L_2}}$$

In order to determine the coupling coefficient in the case of such an oscillation transformer as that shown in Fig. 2 it becomes necessary to determine the values of L, L_1, L_2, M_1, M_2 and M_{12}. Such oscillation transformers are usually constructed of a continuous spiral of wire, no provision being made for opening the circuit of the coil at points along its length. For this reason an indirect method is necessarily pursued in obtaining the value of certain of the constants, a good method being as follows, reference being had to Fig. 2:

(1) Disconnect the condensers C_1 and C_2 by opening the circuits at 1, 2, 3 and 4.

(2) Ascertain L_1 by measuring the inductance across the terminals 1 and 3, the terminals 2 and 4 being disconnected.

(3) Ascertain L by measuring the inductance across the terminals 2 and 3, the terminals 1 and 4 being disconnected.

(4) Ascertain L_2 by measuring the inductance across the terminals 2 and 4, the terminals 1 and 3 being disconnected.

(5) Ascertain the inductance $\lambda_1 \equiv L_1 + L + 2M_1$ by measuring across the terminals 1 and 2, the terminals 3 and 4 being disconnected.

(6) Ascertain the inductance $\lambda_2 \equiv L_2 + L + 2M_2$ by measuring across the terminals 3 and 4, the terminals 1 and 2 being disconnected.

(7) Ascertain the inductance $\lambda_3 \equiv L_1 + L + L_2 + 2M_1 + 2M_2 + 2M_{12}$ by measuring across the terminals 1 and 4, the terminals 2 and 3 being disconnected.

By the foregoing process the inductances L_1, L and L_2 are ascertained directly, while from the last three measurements the mutual inductances are found to be

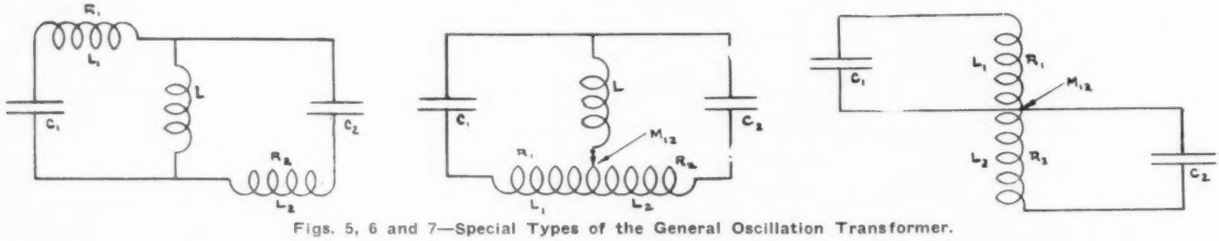
$$M_1 = \frac{\lambda_1 - L_1 - L}{2}$$

$$M_2 = \frac{\lambda_2 - L_2 - L}{2}$$

and

$$M_{12} = \frac{\lambda_3 - \lambda_1 - \lambda_2 + L}{2}$$

In determining the inductances L, L_1, L_2, λ_1, λ_2 and λ_3, no matter what method be used, great care should be exercised to prevent the capacity of the "dead ends" or unused portions of the coil from prejudicing the results. In this connection it is to be noted that in its reaction on the portion of the coil in use the apparent capacity of such a "dead end" or open-circuited portion of the coil may be enormously greater than its real or electrostatic capacity. This matter of the reaction upon the used portion of a helix due to an unused portion is a very interesting if somewhat intricate subject. Suffice it here to point out that in making the inductance measurements in question the safest procedure is to determine the fundamental natural rate of vibration of the helix as a whole when isolated and then make use of currents of a considerably lower frequency in determining the inductances.



Figs. 5, 6 and 7—Special Types of the General Oscillation Transformer.

To determine the fundamental natural rate of vibration of a helix it is sufficient to treat it as if it were an aerial or radiating conductor whose fundamental natural rate of vibration was to be observed. One end of the helix is left open while the other is connected to the upper ball of a spark-gap, the lower ball being connected to earth. The helix is now charged to a high potential and permitted to discharge to earth, while a wave meter, calibrated to short wave lengths, is brought into the neighborhood of the helix, but not into contact with it nor into close inductive coupling with it. In this way the frequency of the fundamental natural vibrations of the helix when isolated is determined.

The method of determining the constants in the case of the oscillation transformer of Fig. 2 is given above at considerable length as this is the most difficult case. A similar but somewhat simplified procedure will answer in the case of all the other oscillation transformers shown.

IMPROVEMENT IN ELECTROPLATING.

In most of the technical works where there is a department for so-called galvanizing—the number is daily increasing—there are besides the ordinary articles which may be hung in the bath in the usual way large quantities of smaller ones which must be coated with nickel, brass or zinc, so that they will not only look well and wear well, but also not cost too much. This is especially the case in factories where gilt buttons, buckles, etc., are made in large quantities, and also in the manufacture of lamps, parts of bicycles and sewing machines. Here there are used electroplating sieves made of woven-metal wire in which the articles to be plated are laid and which are hung in the bath. Apart from the fact that only comparatively small articles can be handled in this manner, handsome and durable work is not always the result. The larger part of the current is taken up by the sieve itself, which soon becomes thickly coated. The articles in the sieve, however, are shielded along certain lines by its wires and receive less metal in these places. In order to get a good coating the current must be strong and the operation prolonged. Otherwise sometimes as much as nine-tenths of the plating metal is deposited on the sieve or basket.

In order to do away with this difficulty a new sieve or basket has been placed on the market in Germany by the Langbein-Pfaunhauser Works by the use of which up to 660 lb. of small articles per day may be well coated; there is also a smaller type which handles only about 330 lb. per day. The articles to be plated are placed in the machine, about 50 lb. at a time, and left in the bath under the influence of the current about twenty to thirty minutes, without any attention being necessary.

ENVELOPE OR THIN PLATES FOR STORAGE BATTERIES.

By Stockton H. Mortimer.

The demand for an increased specific output in the lead storage battery has brought out in the last few years a number of interesting patents and improvements which tend to increase the watt-hour output per pound of complete battery by decreasing the weight of the grid or support. Two methods are conspicuous among these and show the tendency of development, namely, the envelope type, in which an effort is made to confine the active material to the support by a porous covering and the standard grid of reduced thickness with no artificial means of retaining the material other than the proper construction of the grid itself.

It is the intention of this article to discuss the features that are characteristic and of particular interest in these types, showing in a general way the advantages gained and the faults developed, with only such references to individual makes as are necessary to clearness.

One type of envelope plate is made of a number of ladder-like strips fastened together at the top and bottom, filled with lead oxide and coated with liquid celluloid, spaces being left between the strips to allow for circulation of the electrolyte. The celluloid when hard is slit into a number of horizontal strips to give the electrolyte access to the active material. This plate gives good results in laboratory tests, but fails in service on account of the active material forcing off the weakened celluloid coating.

Other types are made with the active material in strips or rods over conducting cores, and the cores are fastened into end pieces which serve as sides or ends for the plates. In one type the envelope is a porous tube of clay; in another, of the same general type, rubber washers are slipped over rods of active material and reinforcing strips are placed across the plate at intervals to correct the natural tendency to buckle. When these types are used in severe service or do not receive experienced care buckling occurs and the tubes are either split or forced open, which allows the material to escape from the envelope. The advantages claimed for these types are an increase in output per pound, an increase in their life and a decrease in the labor in washing out the cells, for it is evident that so long as the envelopes remain unbroken no sediment can collect in the bottom of the jars. The inherent faults are the weakness of the envelope and the tendency to buckle. As the grid is not designed to support the active material, but only to act as a conductor of the current, the life of the plate is entirely dependent on the life of the envelope, and any failure of this covering results in the rapid deterioration of the cell.

During charge and discharge the conductors and the active material expand, but this action is not equal in all parts of the plate, being greatest near the edges and less vigorous toward the center of the plate. This sets up a strain in the plate which would cause it to buckle if means were not taken to prevent it. This condition is innate in all plates, but can be overcome by proper design of the grid.

The envelope type made of a number of narrow strips in each plate is particularly affected by this unequal expansion, for the outside members are more strongly acted on than the central members, with a consequent tendency to distortion of the individual strips, causing the envelopes to open and expose the active material to the direct action of the electrolyte.

In the other class are those plates which depend on the proper construction of the grid to hold the active material and to so distribute the current as to prevent unequal expansion. This result can be obtained by designing the grid so that the resistance is equalized between the lug, the center and the edges of the plate. This is obtained to a remarkable degree in those plates having diagonal or diamond lattices. Thin-plate construction requires a grid having members that cross each other in the spaces occupied by the active material, so that the material is locked between the bars even when the thickness is reduced to the point beyond which no advantageous results are obtained. Grids the members of which do not cross on being reduced to a corresponding thickness are practically a conducting sheet with a series of openings extending through the sheet so that the grid acts merely as a support and does not tend to hold the material in place.

The fault in the unprotected type is the loss of the active material during service. This loss is very slow in properly constructed plates and can almost be neglected in the best types of thin plates where the jars have deep sediment spaces. In many of these batteries the sediment need not be removed during their entire life, although the total mileage is greater than that obtained from a thick-plate battery in the same size cells. The thin plates have been on the market for several years and from the beginning showed such increased specific output that to a great extent they have displaced the heavier

types even in the largest trucks. They have a greater total mileage, are more economical than the thick plates and are being installed in most of the new trucks, which is the criterion of reliability in battery service.

The envelope type, being in the experimental stage, is the most interesting type, and, therefore, has been treated at some length in this article. Theoretically it should give a large output per pound and a long life, but in order to obtain these results it is necessary for the envelope to be very thin and the core light. These conditions have not been obtained in practice without sacrificing either the life or the specific output of the plate, and all efforts so far have served to show that these conflicting conditions cannot combine in commercial plates. Envelope plates have been used abroad to some extent and experimentally in this country, but the weaknesses developed by local conditions have shown that they are not equal to the more rugged type of uncovered plates.

ELECTRICITY IN AERODROMES.

The yachtsman who has had to steer his boat into a narrow channel or slip knows how difficult, if not impossible, it is to do so without scraping the sides of the vessel when a strong wind is blowing at any considerable angle to the opening of the channel. The difficulty of squarely entering an opening in the face of transverse air currents is all the more serious with an aerial craft, which must also allow for variations in its height above the ground. Particularly is this true in the case of a dirigible balloon of the Zeppelin type which exposes a large surface to catch side winds even after the balloon has partly entered its shelter. Consequently, the designer of a practical aerodrome for dirigible balloons must reckon with the wind problem liable to influence his plans. Such provisions have been made at recently erected and proposed structures. In the early ones erected at Metz and at Tegel each end is closed with a huge pair of doors which slide into compartments extending sidewise of the building at its ends, thus exposing the balloon to the side winds the moment it projects beyond the building. In the more recent aerodrome erected at Strassburg this sliding door construction was abandoned at the importuning of the Zeppelin company, the ends being closed by folding doors opening out only a little beyond the lines of the sides, thus protecting the craft from side winds

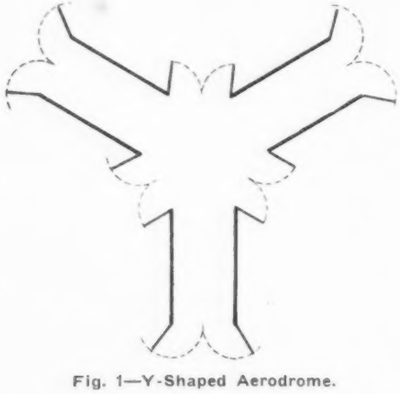


Fig. 1—Y-Shaped Aerodrome.

while leaving or entering. In each case the doors are operated by electric motors, which is also the case with the bellows-type doors on the aerodrome at Friedrichshafen.

However, with any wind beyond a mild breeze the security afforded even by wide doors will vary with the direction of the wind. If the aerodrome were planned like a round-house so that the dirigible could leave through a door facing the wind, the risk would be reduced to a minimum. Upon this thought some recent designs are based, as, for instance, the polygonal type patented by Hans Kirchner for the Gesellschaft Harkort at Duisburg, which involves motor-driven equipment for bringing the dirigible to face the desired opening. The same firm has also designed a Y-shaped aerodrome having exit doors at the junction and also at the ends of the wings. In this type of building the balloon can be moved from one wing to another, or can be turned around by such maneuvering.

Still more radical in design is the type of aerodrome proposed

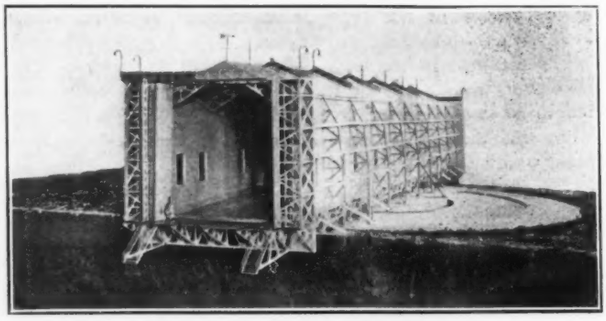


Fig. 2—Electrically Rotated Aerodrome for Dirigible Balloons.

by the structural steel works of August Kloenne at Dortmund, where the whole building is to be revolved to the desired position. The structure in this case is placed on trucks running on a circular track. To reduce the friction on this track, the structure is erected on a round float 32 m in outside diameter. The building, which is shown in Fig. 2, is 150 m long and 20 m wide. By raising the float with compressed air supplied by a motor-driven compressor the trucks are partly relieved of the weight and the building can easily be rotated by a 50-hp electric motor. The weight of the building alone is about 900 tons.

The risk of gas leakage makes incandescent electric lamps the only safe means for lighting such structures. The use of electric power for opening and closing the doors, for moving the dirigibles while in their housings and for turning the whole structure offers a new field in which some interesting problems still remain to be solved.

ELECTRIC FURNACES IN SWEDEN.

Experiments for melting iron ore by means of electricity were first made in Sweden in 1906 at Domnarfort and have since been going on continually with different kinds of furnaces. An experimental furnace used at Domnarfort has recently been removed to make place for new improved ones. Ten furnaces will be built for one company, the Stora Kopparbergs Bergslags Aktiebolag, the first one being under erection now. This indicates that the manufacture of pig iron in electric furnaces is permanently established in Sweden. The new power station at Bullerforsen, which has a rating of 24,000 hp, is to furnish the energy until a new station which it is planned to erect at Forstivfvud shall be finished. One furnace will be ready in February this year and is designed for an annual production of 12,000 tons of pig iron. It will cost about $11,000 and will use about 4000 hp.

One experimental furnace is being erected at Trollhättan by the Järnkontoret which is designed for an annual output of 7000 tons and will require 2500 hp.

At the Högaräs works ten furnaces will be built, the first one being nearly ready. Each one of these furnaces will have a yearly production of 10,000 tons to 12,000 tons.

The above-mentioned plans for refining iron ore involve a yearly production of approximately 250,000 tons. This will increase the total output considerably, although some of the old furnaces will be abandoned. Of great economical value

will be the utilization of water-power for generating the electrical energy instead of buying coal from other countries. Plans in regard to new and still larger installations are under consideration and will probably be heard from in the near future.

MIXED-PRESSURE TURBINES AT RACINE, WIS.

The Racine (Wis.) plant of the Milwaukee Electric Railway & Light Company at present consists of four engine units. Three of these are belted, and it is intended to dispense with them as a result of the reconstruction and additions now in progress. The fourth direct-connected unit is a 1500-kw General Electric generator driven by a cross-compound horizontal Fulton engine. A similar Fulton engine, which is direct-connected to a 1500-kw Westinghouse generator, is now being installed. Both are direct-current 500-volt machines. To receive the exhaust of these engines two horizontal 1250-kw mixed-pressure Curtis turbines, driving 60-cycle, 2300-volt alternators, will be installed. One of the present belted engines drives both a 500-kw, 60-cycle alternator and a 500-kw, 600-volt railway generator on the same shaft. This unit will later be used as a motor-generator set between the turbines and the engines when the reconstruction is completed.

A new building of steel and masonry construction with concrete roof is being built to house the turbines just described. This building will be extended over the existing machinery, replacing the present building, which is not fireproof and is not high enough to permit the use of a traveling crane. For the present the boiler equipment will not be changed, but the building is so designed that the modern structure may be later extended to the boiler-room. At present there are four Stirling boilers of an average capacity of 300 hp each and two Standard boilers of approximately the same size. The condensing apparatus for these turbines consists, for each machine, of a 4500-sq. ft. Prescott surface condenser with rotative dry-vacuum pump and single-stage centrifugal hot-well pump. The circulating pumps for these condensers are of the 14-in., two-rotor Worthington type, each driven by a 50-hp induction motor. The 30-in. Hoppes separator in this plant is common to both turbines.

Central Station
Management, Policies and Commercial Methods

FREE PORCH LIGHTING.

By order, of the city authorities the municipal plant of Greenwood, S. C., will supply electricity without charge to 40-watt tungsten lamp installations on front porches. The conditions are that the owners or tenants of the houses will properly install and maintain a rigid pendent fixture 18 in. long, so located on the porch that the lamp will also light the sidewalk. It must not be placed behind vines or shrubbery and must be kept burning from 6 p. m. to 7 a. m. The municipal plant furnishes fixtures and lamps at actual cost.

ITEMS OF COST OF ISOLATED-PLANT OPERATION.

Where isolated plants are operated for furnishing electricity for lighting and motor service to buildings, factories, etc., proper account is seldom taken of the many items of expense which enter into the final cost of producing a kw-hour at the terminals of the consuming device. The Commonwealth Edison Company of Chicago has prepared an attractive circular entitled, "Do You Know What It Costs You?" the feature of which is a tabulation of the various items which are properly included in the cost of isolated-plant operation. This list, with blanks, in which it is suggested that the plant owner or operator insert his figures, is as follows: Salary of engineers; salary of firemen; salary of electricians; fuel; removal of ashes; water; oil; repairs to boilers; repairs to engines and dynamos; lamps; carbons; tool account; miscellaneous expenses and supplies, waste, packing, etc.; general expense; depreciation (10 per cent to 15 per cent); interest on investment; taxes; insurance; rental value of space; damages resulting from heat and vibration; risk to employees and the public through accidents and boiler explosions; Edison throw-over service; total.

The total obtained by summing up these items will usually cause considerable surprise to the unsuspecting owner of the isolated plant. This total cost, of course, makes no reference to the superior convenience of central-station service, its ready availability at all times, especially when extra or night work is to be done in one department, and the cleanliness of central-station operation from both the consumers' and the municipal viewpoint. The fourth page of the circular concludes with a list of twenty large Chicago consumers now using central-station service for both lighting and motors who formerly employed isolated plants. These loads recently connected to the central-station lines aggregate 15,000 hp in motors and the equivalent of nearly 50,000 16-cp lamps.

ELECTRIC PUMPING AT WALLA WALLA, WASH.

The Pacific Power & Light Company, through Mr. W. B. Foshay, general manager, has made a proposition to supply electric energy for irrigation purposes which has been accepted by a large number of farmers in the vicinity of Walla Walla, Wash. It was originally intended that an energy-transmission line should be built four miles into the country, but the plan has been received with so much favor that the line will be greatly extended. The first line will be completed by April 1 and will supply about sixty-five pumping plants, and it is expected that by July 1 this number will be increased to at least 100. The pump motors will be from 3 hp up to 40 hp or 50 hp, according to the number of acres of land a consumer will have under cultivation. The Pacific Power & Light Company is building the line and will furnish meters and transformers, the consumer furnishing a time switch and the pumping equipment. The business will be all off-peak, the time switch cutting off the supply for four hours during the evening peak.

A PRINTER'S SAVING BY REPLACING GAS ENGINE WITH MOTORS.

The Advent Publishing Company, doing newspaper and job printing at Mendota, Ill., formerly employed a 4-hp gasoline engine to operate its presses. Gasoline for the engine cost $17 to $22 a month, in addition to which there were heavy charges for repairs and maintenance of the engine. No account was kept of the items of labor or attendance, but the manager of the shop estimated that during the time the engine was installed his actual outlays in supplies and repairs had averaged $33 a month. The difficulty of getting expert attendance, as well as the time lost during breakdowns, made the operation of the isolated plant a source of great annoyance and expense.

Mr. C. F. Lathrop, manager of the Mendota Electric Light Company, proposed to the printer that by substituting several

small motors for the clumsy and inefficient engine and shaft drive all trouble would be entirely avoided and the cost of operation would not at the utmost exceed that by the engine. In the meanwhile additional presses and machines were added, so that when motor drive was installed a 5-hp motor was put in to run two cylinder presses, a 1-hp motor to drive three job presses on the second floor and a ½-hp motor to operate the typesetting machine. The monthly bills of the printing establishment have since averaged from $9 to $12, under a sliding-scale rate schedule in which the equivalent of 8.5 cents is charged for energy consumed up to 25 kw-hours, the rate decreasing to 5 cents a kw-hour for all used over 200 kw-hours. The resulting low cost of electric drive has surprised both the central-station man and the printer, the latter having dismantled his gas engine and disposed of it. This excellent showing of electric service has in part been due to the substitution of direct motor drives for the inefficient shafting formerly carried through the shop, and to the elimination of the long-hour runs of the gas-engine outfit to drive only the typesetting machine, now run by a ½-hp motor.

BOSTON EDISON COMPANY SPREADING ELECTRIC COOKING GOSPEL.

The Edison Electric Illuminating Company of Boston has recently been giving special publicity to the use of electricity in cooking, citing the order of the Secretary of the Navy for the establishment of electric cooking on battleships as the most significant recent advance in the art. All the suburban district offices of the company have been supplied with lithographed quotations from the specifications as clipped by permission from a confidential copy of the contracts for building battleships Nos. 34 and 35, which are on file in the Bureau of Construction and Repair of the Navy Department, showing in detail the equipment of the galley outfit and electrical auxiliaries to be installed. The company points out that the contracts for these battleships call for complete electrical equipment for every purpose in the "kitchens," including two electric ranges, warming ovens, bake ovens, urns, grinders, slicers, mixers, washers and other apparatus. The company recognized the importance of the adoption of electricity for battleship cooking as soon as it was announced, and sent a representative to Washington on a flying trip for the purpose of getting in close touch with the details. Much interest in the subject has been aroused by the company's lithographic reproductions.

ADVERTISING BY ELECTRICITY.

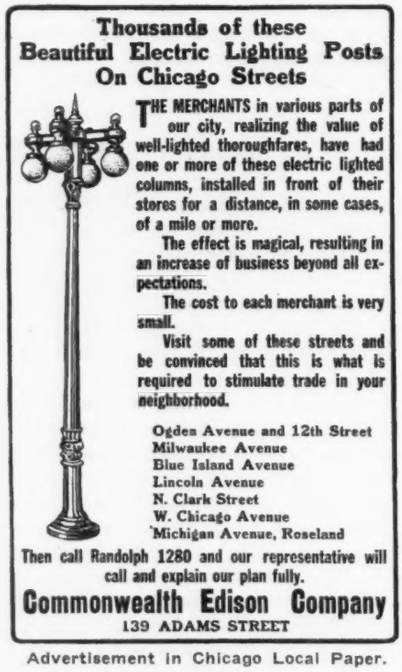
An electric advertising campaign has been started in Baltimore, commencing with an address recently by Mr. O. P. Anderson before the Baltimore Section of the National Electric Light Association in the physical laboratory of Johns Hopkins University on "The Design and Construction of Electric Signs." Later, upon the invitation of President Francis Lawton, Jr., Mr. Anderson addressed the Advertising Club of Baltimore at its mid-day luncheon in the Merchants' Club and chose as his theme "Advertising by Electricity." Mr. Anderson, who is an illuminating engineer of one of the lamp manufacturing companies, pointed out in his lecture before the Baltimore Section, N. E. L. A., that several cities of the United States are making commercial progress because the merchants of these cities believe in what he termed "co-operative illumination." He mentioned New York, Minneapolis, Chicago, Cleveland, Columbus, St. Louis and Buffalo as examples of cities that are growing larger by becoming brighter. He also pointed out that Baltimore Street, the main business thoroughfare of the Monumental City, has become a greater business street since the additional illumination has been installed.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, is now actively engaged in promoting facilities by which Baltimore may take its place in the front rank in the matter of illumination. Already arrangements have been made to bring two sign concerns to Baltimore which will sell, install and maintain their signs as well as solicit business. Many merchants have already signified their intention to install signs, and the fact that they can be paid for in twelve monthly instalments and maintained during that time is an excellent inducement.

The city government has become interested in the campaign, and if an ordinance which has just been drafted by City Solicitor Poe meets the approval of the City Council, it will not be necessary for a man who desires to place an electric sign in front of his premises for advertising purposes to have an ordinance passed through the Council. All that will be necessary will be to appear before the Board of Estimates and present an application. This will save firms the expense of engaging a lawyer to draw up an ordinance and the delay necessary to have it passed through the Council. The Consolidated Gas, Electric Light & Power Company appeared before the board last week and requested it to suspend the rule requiring that permits for electric signs more than 6 ft. in length be incorporated in special ordinances. The company explained that there was much time lost in the passing of these special ordinances, and as the city had expressed its willingness to co-operate with the merchants and the company in making Baltimore brighter, there was no good reason why this rule should not be suspended. The board is considering the request.

ADVERTISING SPECIAL LIGHTING IN OUTLYING DISTRICTS.

In making its vigorous campaign for special ornamental street lighting designed to attract business to various neighborhoods in outlying districts, the Commonwealth Edison Company of Chicago has done some newspaper advertising. A reproduction of such an advertisement is shown herewith. These "ads" are not printed in the big downtown dailies, but rather in the vicinity papers of the outlying residence districts, each of which has one or more business streets. The sample given herewith appeared in a paper published in Woodlawn.


Thousands of these
Beautiful Electric Lighting Posts
On Chicago Streets
THE MERCHANTS in various parts of our city, realizing the value of well-lighted thoroughfares, have had one or more of these electric lighted columns, installed in front of their stores for a distance, in some cases, of a mile or more.
The effect is magical, resulting in an increase of business beyond all expectations.
The cost to each merchant is very small.
Visit some of these streets and be convinced that this is what is required to stimulate trade in your neighborhood.
Ogden Avenue and 12th Street
Milwaukee Avenue
Blue Island Avenue
Lincoln Avenue
N. Clark Street
W. Chicago Avenue
Michigan Avenue, Roseland
Then call Randolph 1280 and our representative will call and explain our plan fully.
Commonwealth Edison Company
139 ADAMS STREET
Advertisement in Chicago Local Paper.

Four-light or five-light posts equipped with 60-watt or 100-watt tungsten lamps are used, and about 1600 of these posts have been placed in various neighborhoods in Chicago. The in-

stallation of these systems is generally handled by business men's associations in the various districts. The posts are of iron and painted black, and usually one is placed in front of the store of each subscribing merchant. The lighting service is from dusk until 10 p. m. for six nights a week and from dusk until midnight for one night a week, the rate for each subscribing merchant being $1.50 per post per week for four 60-watt lamps. In order to get this rate it is necessary that there shall be twenty-five or more subscribers in each district. The company makes the complete installation and maintains it. The contract period is two years.

CENTRAL-STATION RESULTS AT FITCHBURG, MASS.

The return of the Fitchburg Gas & Electric Light Company to the State for the year ended June 30, 1910, shows that electricity is being popularized to an increasing degree in the northern Worcester County manufacturing city served by the organization. The company is one of the Tenney organizations and has an electric and gas department under the supervision of a local manager, who is responsible to the headquarters offices of the associated companies at Boston. The gross income of the company's electrical department for the year was $153,370, an increase of about 12.5 per cent over 1909. Of this revenue commercial lighting service furnished the larger portion, or $60,230, and the revenue from energy used by motors was $55,291. There was a gain of about $8,200 in commercial lighting over 1909, and the gain from industrial loads was about $5,100. The company's income from street lighting was $35,205 in 1910, compared with $33,666 in the preceding year.

The operating expenses of the company for 1910 were $100,595, compared with $87,085 the year before. The principal items of operating expense this year were: Net cost of manufacture at station, $47,711; distribution, $15,791; office expenses and management, $19,066; taxes, $10,399; miscellaneous, including insurance, legal, etc., $7,628. The balance to profit and loss for the present year was $52,775, compared with $49,523 the year before.

The cost of the physical plant of the electrical department to June 30, 1910, was $574,926. The company increased the plant investment by about $21,600 during the year. The larger items of plant cost for 1910 were: Underground lines, $161,001; steam-plant equipment, $142,904; land, $95 325; electric plant equipment, $82,799, and overhead lines, $50,511. The company expended $8,400 on additional overhead-line construction in the fiscal year 1910. Practically no change was made in the steam and electric generating plant equipment.

The company generated 4,461,580 kw-hours in 1910, compared with 4,006,157 kw-hours the year previous. Its gross income per kw-hour sold was 4.25 cents. For street lighting the company supplied 710,800 kw-hours; for commercial lighting by meter, 483,928 kw-hours; for general commercial lighting, 2,904,139 kw-hours, and for electric motor service, 2,401,440 kw-hours. The average income per kw-hour sold to motor users was 2.3 cents. The company sold or accounted for 3,978,987 kw-hours, leaving 482,593 units unaccounted for. The maximum load was 1650 kw and the maximum load on the day of least output was 320 kw. During the year the company burned 5443 tons of coal and 1573 tons of coke, besides a small amount of other fuel. The average cost of the coal per ton was $4.31 and of the coke $3.50. The station capacity was 2000 kw. The company's connected load was 2675 kw, including electric motors, 1538 kw, and commercial lighting, 982 kw. On June 30 last the company owned 2408 poles, and operated a total length in wire of 786,723 ft., divided as follows: Municipal wire, 356,985 ft.; commercial primary lighting wire, 123,103 ft.; secondary, 124,703 ft.; power primaries, 142,840 ft.; motor secondaries, 39,092 ft. The station service was handled by three engine-driven alternating-current generators delivering current to the distribution system at 2300 volts. There was an increase of about 96,000 ft. in the length of overhead wire in the year.

A summary of the company's operations, including various unit figures, is given in the accompanying table:

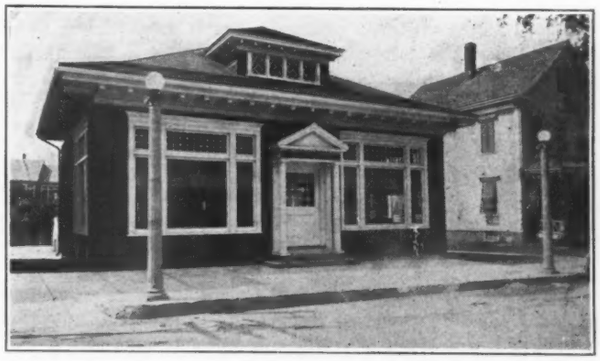
ANNUAL RETURNS OF THE FITCHBURG GAS & ELECTRIC LIGHT COMPANY.

Kilowatt capacity of station, rated	2,000
Total population of district served, Census of 1910	37,826
Gross yearly income per kilowatt station capacity	$76.68
Per cent income expended for operation, excluding interest and depreciation	65 per cent
Investment in electric plant and property	$574,926
Yearly operating expenses per $100 invested	$17.50
Average income per consumer	$158
Total connected load per kilowatt station capacity	1.337 kw
Connected load in motors per kilowatt station capacity	.765 kw
Kw-hours accounted for per 100 kw-hours generated	89
Yearly load factor	30.8 per cent
Gross yearly income per capita	$4.05
Investment per capita in electric plant	$15.20
Watts station capacity per capita	53
Number consumers per 100 population	2.56
Number residence consumers per 100 population	2.35
Number of residences, Oct. 1, 1910	4,528
Number of residence consumers, Oct. 1, 1910	890

Wiring and Illumination

SPECTACULAR LIGHTING AT REVERE, MASS.

Revere, Mass., a suburb of Boston, possesses numerous seaside resorts, where, as at other places of the same kind along the Atlantic seaboard, electricity is very largely employed for spectacular lighting in addition to regular uses. Electrical energy is supplied from the mains of the Suburban Gas & Electric Company, which has recently erected a new office building in the town for the convenience of its patrons. As shown in the accompanying engraving, the bungalow style of architecture has been adopted and the building is provided with attractive outdoor illumination in the shape of reinforced-concrete posts fitted with 60-watt tungsten lamps fed from a 104-volt circuit.



Office of Suburban Gas & Electric Company at Revere, Mass.

A special summer lighting installation is on the Revere Beach boulevard, where the company supplies energy to about 200 flaming arcs located inside the amusement concessions. The street itself is lighted by twenty-two arches, each arch having fifty-two lamps of 8 cp each, the span across the boulevard being 43 ft. and the height of the arch centers 22 ft. In subagencies the company uses a sign shaped like an incandescent lamp to call attention to the place. From fifty to 100 lamps of 8 cp, frosted, are used in these signs, according to whether both sides are available for display purposes or not. A large billboard sign of the company's erection is illuminated nightly by incandescent lamps near the Boston & Maine Railroad.

At Wonderland Park, Revere, the company has a summer lighting load of about 2000 kw maximum. This is a large amusement resort where a striking amount of outline lighting is done. The company has had the business for five years. Service is supplied by four 50-kw transformers which step

down the potential from 13,200 volts at the line side of the property to 130 volts and 230 volts for lamps and motors. Three-phase, four-wire service with a grounded neutral is installed on the secondary side of the transformers. The season lasts from May 30 to Labor Day, and the load is carried nightly until midnight. A brick substation, 40 ft. x 25 ft., handles the switching and transformer installation, and the park guarantees a minimum consumption during the season of 750,000 kw-hours.

SPECIAL LIGHTING AT WATERVILLE, MAINE, FOR BRIDGE-OPENING CELEBRATION.

During a celebration at Waterville, Maine, some time ago the lighting and railway companies combined to make the place attractive by night for two weeks. The occasion was the opening of a bridge by the Lewiston, Augusta & Waterville Street Railway Company. The Waterville & Fairfield Street Railway Company furnished the electricity to light festoons

Special Illumination at Waterville, Me.

stretched across the street and the Central Maine Power Company supplied the energy for three-quarters of a mile of festoons arranged on the buildings. The lamps used were rated at 4 cp and 8 cp, and the illuminated zone was capped at each end by a luminous-arc lamp. The accompanying illustration is a view of the street at the time of the bridge opening.

GLARE AS AN AID TO STAGE ILLUSIONS.

Those who were familiar with the plans for amusing visitors in and about the grounds of the World's Columbian Exposition at Chicago will recall the Mackaye Spectatorium, which was wrecked by fire while yet unfinished. One of its novel features was the curtain, which was not to be of cloth or other opaque material, but of brightly lighted vapor. The plan was to have a film of vapor rise at the footlights and to project rays of light edgewise through this so as brightly to illuminate it, thereby screening the stage from the view of the audience.

While the trial of this clever arrangement on such a magnificent scale was unfortunately prevented by a disastrous fire, a little of the same sort of screening is often used in connection with the theaters which have been multiplying at such a remarkable rate during the last few years. Fortunately, the mist or vapor which Mackaye proposed to use in his venture is generally absent, but to make up for this some of the light beams are often turned directly toward the audience so as to effect by their glare part of what Mackaye sought to accomplish with his light-diffusing film of vapor.

The effect of this glare in reducing the visual acuteness is being utilized by a pantomime comedian who has just been appearing in vaudeville at the Plaza Theater, in Chicago. His using the glare effect there is all the more pronounced and successful as the little playhouse is lighted largely by indirect methods so as to screen carefully the observer's eyes from direct light rays. The curtain rises on a stage setting of black cloth at back and sides, with the comedian and his paraphernalia dimly illuminated by diffused light from the auditorium of the theater and by a little direct light from a crescent moon hung against the rear drapery. This hazy stage setting readily lends itself to the mystifying and often "spooky" pantomime in which the comedian conjures birds and even large musical instruments out of the darkness and breathes life into a figure which he has just glued together out of the stuffed limbs and members.

When other performers have presented similar tricks they have usually depended upon rapid sleight-of-hand work in the passing of objects through secret flaps in their elaborate stage setting or the similar substitution of live persons for dummy figures. The present manipulator varies this by working with a very simple stage setting and in a light which would be barely ample for disclosing the methods of his tricks if his audience were accorded the full use of their eyes. To avoid the latter he works behind a row of fifteen incandescent lamps of about 8 cp, each supported some 3 ft. above the stage floor on a little standard and each fitted with a metal half shade. By reversing the usual practice and turning the shades so as to throw the light into the eyes of the spectators he reduces their visual acuity just enough to hide the mechanism of his tricks, while still allowing them to enjoy them. Consequently the audience sees the dummy while it is being assembled, but does not see the drapery part when an assistant substitutes himself for the stuffed figure. Nor does it see the wires and rods by which various other paraphernalia are manipulated; hence the effect is pleasantly mystifying. No argument should be needed by illuminating engineers to prove the mistake of having lamps shine directly into the eyes other than the success of this vaudeville artist in thereby keeping his audience from seeing a part of what otherwise would be clearly visible to them.

TUNGSTEN STREET LIGHTING IN BOSTON.

The Edison Electric Illuminating Company, of Boston, Mass., has in the neighborhood of 1000 40-cp tungsten lamps in city

Fig. 1—Lighting of Charles River Basin Promenade.

street-lighting service, which have displaced gas and naphtha lamps. As pointed out in the Sept. 1 number, a departure from ordinary practice was made by the company in connection with

the lighting of the Charles River Basin; West Boston and Harvard bridges, the Basin Promenade and Back Street being illuminated by multiple-series tungsten lamps ranging in size from 60 cp to 100 cp. The lamps are connected in series across the underground, three-wire direct-current network, and are hung about 11 ft. above the walks. Multiple lamps could not be used on the bridges because of the vibration, and high-tension series circuits were out of the question owing to the installation of the lamps on iron posts. To protect the lamp from weather and breakage a clear outer globe is provided. The installation on Back Street, a narrow thoroughfare at the rear of the Beacon Street residential estates, consists of 60-cp tungsten lamps fed from multiple-series circuits and carried on ornamental iron posts, as shown in the engraving herewith. The installation has transformed what was a poorly lighted street with flickering gas lamps to a brilliantly lighted thoroughfare. For 60-cp, 80-cp and 100-cp lamps the company receives $12, $14 and $18 per year as fixed charges plus 3 mills, 4 mills and 5 mills respectively per lamp-hour as running costs.

Fig. 2—Lighting of Back Street, Boston.

RECENT TELEPHONE PATENTS.

NEW AND IMPROVED APPARATUS.

A patent granted to Mr. B. W. Sweet, of Cleveland, Ohio, describes an improved desk stand wherein all working parts of the circuit are confined to the hollow stem of the stand. He shortens up the hook-switch springs so that they occupy the top part of the stem and below this is stowed a specially shaped induction coil designed to withstand the longitudinal strain caused by the frequent setting down of the stand. By including the induction coil in the stand a two-strand cord is sufficient. This reduces cord costs. This patent has been assigned to the Century Telephone Construction Company.

The patent granted to Mr. C. J. Erickson, of Chicago, relates to a harmonic signaling type of ringer. The exposed ends of the magnet cores are each provided with a slot, which supports the non-magnetic cross bar. This is accomplished by punching button holes in the cross bar, through which the cores are inserted. When the cores are assembled they are thrown outward so that the slots engage the cross pieces to clamp the whole securely in position. The cross piece carries at its center and at right angles to itself a slip of flat spring, which is securely clamped to it. The ends of the slip spring are then clamped by screws to the legs of a U-piece or yoke which spans the cross piece and which carries the bell hammer and rod. Thus there is provided a flexible torsional spring mounting, to which the armature of the ringer is attached from below.

In a switchboard switching key invented by Mr. K. Weman, of Buffalo, the key lever is carried upon a pin which is clamped between the escutcheon plate and the horizontal element of an angle plate. The middle part of the angle is cut away at the bend, thus forming a space within which the lever may swing. The bottom of the vertical member of the angle carries the upturned switch springs, the actuating members of which carry small rollers which confront the block upon the lever. This block is made of a piece of sheet metal formed into a tube of diamond-shaped cross-section, one edge of the tube being set into a cross slot in the bottom of the lever. Mr. Weman has assigned his patent for this key to the Ericsson Manufacturing Company.

Two patents granted to Mr. H.K. Sandell, of Chicago, describe a service counter for automatically counting messages. The counter is in view of the user and responds to every upward thrust of the hook switch lever. If the current flowing in the line circuit be constantly maintained the counter is restored or stepped back as the lever is again depressed. If, however, the current be stopped even for a very brief interval before the lever is depressed the count will be left recorded. The result is accomplished by a limit magnet, which once released will not restore. In the improved system the operator has the means of setting back the counter and the mechanism is safeguarded against operation by ringing current.

Upon incoming calls or upon attempts of the subscriber to recall the operator no count occurs as the line current is unbroken. Upon an outward call the break of current occurs during the operation of the cutoff relay.

Messrs. W. H. Thompson, of Wheeling, W. Va., and H. R. Stuart, of Milwaukee, have patented a receiver for telegraphones. This instrument is duplex, having two diaphragms lying side by side in the same plane. Instead of the usual ear pieces, the diaphragm caps have central tubular apertures which lead to the two ears of the user. The receiver is of the solenoid type, each diaphragm carrying a cylindrical pole piece which projects into the corresponding receiver coil. Each receiver coil is connected upon an independent circuit to one of the reproducer magnets of the telegraphone. A single polarizing magnet serves for both receiver units.

Most multiple contact transmitters of the present day obtain their contact by the use of granules of carbon. In the transmitter patented by Mr. C. Adams-Randall, of New York City, no granules are used. There are instead a number of contact blocks symmetrically spaced upon the diaphragm, but insulated from it and from each other. Confronting each of these and in flexible contact with it is a carbon block. Multiple or series contacts are obtained as desired by connecting these single contacts together.

Messrs. G. W. Gibberd and O. A. Elias, of London, England, have produced and patented a disinfecting device in the form of a sleeve designed to be mounted between the transmitter proper and the mouthpiece. The walls of the sleeve have radial perforations and a disinfectant container surrounds the sleeve.

For rural lines it is sometimes advisable to provide a station disconnecting device for use in time of storm. Such a device forms the subject of a patent granted to Mr. P. H. Harner, of Dooms, Va. Two sheets of fire-resisting insulating material are hinged together on one edge. One sheet, the base plate, carries the line wire and ground terminals and also the plates of a saw-tooth lightning arrester. These plates are so shaped as to form receptacles for contact wedges mounted upon the cover plate, to which wedges the telephone wires are connected. When the cover is turned down the saw-tooth arrester is left in working position while the telephone is disconnected.

WIRELESS TRANSMITTER.

As a transmitter for wireless telephone signals Mr. H. G. Matthews, of Gloucester, England, arranges a hoop carrying bundles of magnetic wire, the wires laid parallel and at right angles to the plane of the hoops. The whole is surrounded by a ringlike coil of wire placed parallel to the hoop.

RECEIVER HOLDER.

A receiver holder for desk sets is the subject of the patent of Messrs. J. G. Harris and A. Mancuso, of Philadelphia. This comprises a clamp bracket carrying a swinging arm at the end of which is the receiver. The arm can swing forward of its pivot, against a stop, to the listening position, or behind its pivot when it bears upon and holds down the switch hook.

AUTOMATIC SYSTEM SWITCH.

Mr. C. H. North, of Cleveland. Ohio, has patented a switch for automatic systems, having assigned his patent to the North Electric Company. In this switch the contacts are arranged in vertical rows upon a cylindrical surface. Rotary motion selects the proper vertical row and then the spindle is elevated to select the proper terminal. The novelty in the invention lies chiefly in the construction of the switch, especially in the reduction of all electromagnets to a single interchangeable unit adaptable to all needs.

Letters to the Editor.

Regenerative Electric Traction.

To the Editor of Electrical World:

Sir:—I have noted the quotations from the A. I. E. E. standardization rules appended to my letter in your issue of Dec. 29. I was aware of the fact that the term "adjustable-speed motor" had been proposed to be used to denote shunt-wound motors capable of speed regulation by means of field control, but I did not think that it had been adopted, for I have noticed several motor manufacturers still using the term "variable-speed motors" to denote this form of direct-current apparatus. Moreover, the fact that you contrasted the term "adjustable-speed motor" with "shunt-wound motor" instead of "constant-speed motor" led me to believe that you referred to some new development in the regenerative field.

As far as I know all the development in that field during the last ten years has been on the basis of the "adjustable-field" motor. Mr. Robert Lundell described shunt-field regulation in his regenerative patents and used it in his experiments. He also described an equivalent in the form of independent field excitation capable of regulation. He recognized the difficulties of obtaining a wide range of speed variation by field control on account of the limited space generally allowed for the traction motor. Mr. Lundell therefore combined the adjustable-speed principle with series paralleling, as a matter of fact even *double* series paralleling.

In 1902 an equipment was completed on these lines and installed and tested at Newcastle-on-Tyne. An average saving of energy of 25 per cent was found to be effected by this regenerative equipment. Mr. Raworth, making simplicity a first consideration, endeavored to use the adjustable-speed motor without any series paralleling. He found, however, after a few years that the speed variation obtainable in this way was insufficient and the saving negligible under average conditions, and he was compelled to adopt the principle of series paralleling which he had originally denounced.

A lesson brought home by the Newcastle test was the fact that, though armature resistances were practically dispensed with in this regenerative equipment, a saving during acceleration and running on intermediate notches was not discernible in the gross energy consumption. Mr. H. F. Parshall strikingly explained this discrepancy by remarking that the shunt circuit uses up (at the low average loads) what is saved during the acceleration periods by the absence of armature resistances Besides this drawback of the shunt characteristic when applied to traction there are others, all of which have led to the original adoption of the series characteristic for traction purposes.

As I have said before, the shunt characteristic is essential to regeneration, but to my mind there is no objection of any weight against a combination which allows of the use of series characteristic during propulsion and of shunt characteristic during retardation. This combination can be so arranged that the standard series parallel equipment is retained complete and independent for propulsion. Consequently, the objection generally raised against any radical innovation, namely, that of possible lack of service reliability, is removed. The equipment is in that respect as perfect as any.

By using a series-parallel equipment capable of speed variation by field regulation, which kind of equipment was introduced a few years ago in Germany and found satisfactory, a saving can be obtained during the accelerating periods, which saving will amply compensate for the comparatively small loss in regenerative efficiency that would result from abandoning the complication of the *double* series-parallel principle and the adoption of the single series-parallel system. The result would be an equipment of maximum efficiency and service reliability and minimum complication.

Davenport, Ia. J. Gustaf V. Lang.

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—With further reference to the criticisms made by Dr. C. H. Sharp and Mr. L. T. Robinson on Jan. 12 through the columns of the *Electrical World* of the writer's paper on the effects of alternating pressure wave-form on the life of incandescent lamps, which was first published in the June, 1910, *Bulletin* of the Engineering Experiment Station of the Pennsylvania State College, attention should be called to a number of statements made by both Dr. Sharp and Mr. Robinson which are not supported by the best information obtainable bearing on the question under discussion.

The writer is well aware that the burden of proof of claims made by him must rest upon the party who made these claims and he does not intend to disregard the obligation, but this fact in no way prevents his challenging evidence against him when the evidence thus offered is misleading or incorrect. At the present time work is being carried on which, it is hoped, will make it possible to answer directly certain criticisms which for the present cannot be contradicted by direct proof, and in the meantime it is the purpose of this letter simply to point out certain conflicting proofs offered by Dr. Sharp and Mr. Robinson as well as to direct attention to the work of others which may bear upon the case in question.

In the third paragraph of Mr. Robinson's letter he implies that the difference in life of lamps on the two waves is in part attributable to difference in regulation of the two waves. It is true that over any considerable range of voltage variation the saturated iron core used to obtain the peaked wave would have resulted in a poorer regulation of the peaked wave. However, throughout the tests described a recording voltmeter was kept on the alternator and the records show the greatest variation in voltage which occurred. An investigation of the variation of the peaked voltage corresponding to this slight change in alternator voltage showed the difference to be inappreciable. It may be positively stated that no effect worth considering could have resulted from this cause.

Mr. Robinson would lead one to believe that there is almost no change in resistance or temperature of tungsten filaments during a voltage cycle and offers as proof of his inference a test made by Dr. Sharp of a similar lamp on the same frequency (25-watt tungsten lamp on a circuit of 25 cycles). Dr. Sharp in the *Proceedings* of the A. I. E. E., September, 1910, page 1538, in describing this test states that he finds the variation of a tungsten-lamp filament's resistance during a cycle to be such that the minimum resistance is 10 per cent lower than the maximum resistance and that he calculated the power-factor to be 0.99975. It thus seems that Mr. Robinson would try to prove that there is almost no change in resistance or temperature during a cycle and that the power-factor is practically unity by means of a test which Dr. Sharp gives to show that the

temperature does vary and that the power-factor is less than unity, the current leading the e.m.f. by a small amount. Nor can the variation pointed out by Dr. Sharp be considered insignificant, as will be shown later.

The statement made by Mr. Robinson that "there is no large change of temperature in the filament throughout the cycle" in the case of a lamp on a 25-cycle current seems almost absurd. He surely knows that when a lamp is supplied with current at

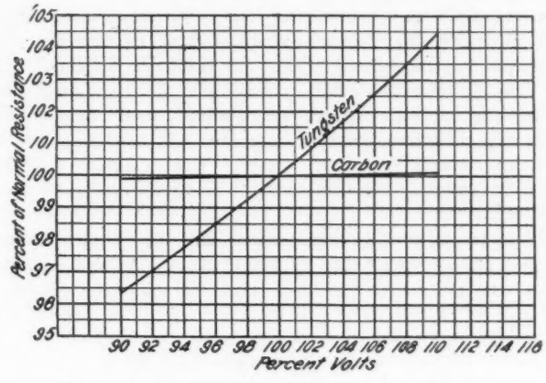


Fig. 1—Variation of Resistance with Voltage.

25 cycles the resulting flicker is plainly visible to the naked eye, and he must also know that this flicker is due to temperature fluctuation.

Returning now to Dr. Sharp's letter, it may be said that the writer cannot, until his tests now under way shall have been completed, attempt to substantiate his claims by further original proof, but it is possible at this time to point to evidence furnished by Dr. Sharp himself which is at variance with his present statements, and it is also possible to present other evidence which is against Dr. Sharp's last-obtained results.

Dr. Sharp in both of his communications to the *Electrical World*, as well as in a personal talk with the writer, objects to the measurement of power supplied to a lamp by means of a voltmeter and an ammeter. The writer fully agrees with his critic in his belief that the absolutely exact value of the true power supplied to a lamp should be measured by a wattmeter. He also agrees that lamps do have a power-factor very slightly less than unity, but, as has been before stated, the makers of the lamps tested at the Pennsylvania State College used a voltmeter and an ammeter in rating these lamps, and for that reason similar instruments were used in connection with the tests; if a lamp has a power-factor which is less than unity, then this power-factor is undoubtedly affected by the shape of the current wave.

From a letter written by Dr. Sharp, part of which will be quoted later, it would seem clear that Dr. Sharp agrees with the above statement, but notwithstanding this the results of tests given by Dr. Sharp in his last letter to the *Electrical World* show that on a sine wave, on a peaked wave and on a re-entrant wave, each of 60 cycles and 110 effective volts, the power supplied to the same lamp as measured by a wattmeter was identically the same in the case of each wave, Dr. Sharp's readings checking to at least four significant figures, thereby showing an agreement within one-tenth of 1 per cent.

If we refer now to a paper by Mr. John W. Howell in the *Proceedings* of the A. I. E. E., June, 1910, page 819, and compare the results given by Dr. Sharp in his letter, which forms part of a discussion of Mr. Howell's paper, *Proceedings*, A. I. E. E., September, 1910, page 1538, and if we assume both to be correct, we obtain additional information bearing on the point in question. Reference has already been made to Dr. Sharp's letter in the *Proceedings*, and it was pointed out that he found the resistance of a lamp filament to have a minimum value which was 10 per cent below the maximum resistance during a cycle when a 25-watt, 110-volt tungsten lamp was used on a circuit of 25 cycles (presumably at its rated voltage); the wave of e.m.f. being *extremely peaked*.

Dr. Sharp states that the peaked wave was selected so that the effect (similar to electrostatic capacity) might be exaggerated, and also that a frequency of 25 cycles was chosen as being as likely as any to give a maximum effect. These statements imply two things: First, that the fluctuations in the resistance and the power-factor vary as functions of the form of the e.m.f. wave, and, second, that the fluctuations in resistance and power-factor probably vary with the frequency. Accepting Dr. Sharp's results and assuming that under the conditions specified by him the minimum resistance of a lamp is 10 per cent lower than the maximum resistance during a cycle, let us compare the results with those contained in Mr. Howell's paper, to which reference has already been made.

Let us assume that the resistance of the lamp tested by Dr. Sharp varied from 105 per cent of normal to a minimum of 94.5 per cent of normal, the latter value being 10 per cent lower than the maximum. Referring to Fig. 4 of Mr. Howell's paper, reproduced herewith, page 824 of the June *Proceedings*, we find that this variation in the resistance corresponds to a variation in voltage of from approximately 85 per cent of the normal voltage to 111 per cent of the normal voltage; and, further, from Fig. 7 of Mr. Howell's paper, reproduced herewith, we find that the above-named variation in voltage corresponds to a variation in candle-power of from approximately 65 per cent of the normal to approximately 130 per cent of normal. From the above it will be seen that if Mr. Howell's work is correct and if Dr. Sharp's work is also correct, then in the case of the lamps tested by Dr. Sharp the candle-power varied twice during each cycle from 65 per cent to 130 per cent of its normal value.

Mr. Howell's paper also gives some information concerning the life of the lamp. In the case of the lamp just considered, Fig. 7 of Mr. Howell's paper shows that at such times as the candle-power was 130 per cent of normal the disintegration of its filament was about four times its normal rate. While it cannot be accurately determined from Fig. 7 what the disintegration is when the candle-power is 65 per cent of normal, yet it cannot be less than zero. Hence, if we may fairly assume, and it is believed we may, that during one-eighth of a cycle the disintegration of the filament of the lamp tested by Dr. Sharp varied constantly from four times normal down to the normal rate, and during the next one-eighth cycle it varied constantly from the normal rate down to zero, etc., we find that under the assumption stated the average disintegration during the whole cycle would be 150 per cent of normal.

Under the above-named conditions, which appear to be entirely fair to Dr. Sharp's argument, if the resistance of a tungsten

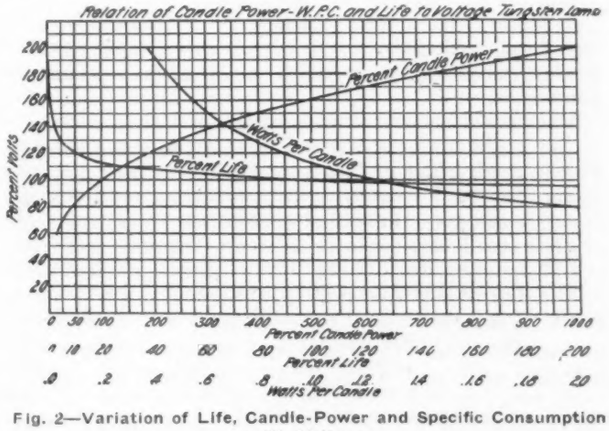


Fig. 2—Variation of Life, Candle-Power and Specific Consumption with Voltage.

filament under the influence of a peaked wave of e.m.f. varies approximately 10 per cent, as Dr. Sharp claims it does, and if Mr. Howell's work may be relied upon, we find that the disintegration is 150 per cent of what it would have been if the resistance had remained unchanged throughout the cycle.

There is every reason to believe that had the wave used by Dr. Sharp been sinusoidal there would have been much less than 10 per cent variation in the resistance, and the changes in

temperature and candle-power would have been far less than they were with the peaked wave used by Dr. Sharp in his test.

Further reference may be made to the April 20, 1907, issue of the *Electrical World*, page 803, where an abstract, accompanied by curves, is given of a paper by Dr. Sahulka, printed originally in the organ of the Austrian Electrical Engineering Association. The tests here reported showed that in the case of certain incandescent-lamp filaments the resistance varied 2.1 per cent throughout the cycle, but this change of 2.1 per cent in resistance corresponds to a maximum change from the mean value in candle-power of 23 per cent. If we may assume that the filament used by Dr. Sharp in his test was similar to that upon which the tests recorded in the *Electrical World* were made, it would seem that, since the resistance varied 10 per cent with the wave used by Dr. Sharp, the candle-power variation could certainly not have been less than 50 per cent.

The question as to a probable error in the measurement of *initial* candle-power reported by the writer is being carefully investigated and a thorough search is being made for any possible influence or condition which could have introduced an error into these readings. It is quite evident, however, that except as an error of this kind would bear upon the initial candle-power reading the results of the life tests already published would not be affected, and it is certainly far from correct to assume that even had an error of this kind existed this was responsible for the greatly reduced life of the lamps on the peaked wave.

Finally, Dr. Sharp has repeatedly placed great emphasis upon his claim that numerous tests of an entirely similar nature to those performed by the writer have been made and that records of these tests are available. If Dr. Sharp, through the columns of the *Electrical World*, will state where these references occur he will be rendering no little service to the men who are deeply interested in this subject and who are at present experimenting along these lines.

State College, Pa. Charles L. Kinsloe.

Wattless Power.

To the Editor of Electrical World:

Sir:—The letter by Mr. Hanchett in your issue of Jan. 12 on the subject of "wattless power," "fictive watts" and "tangible phenomena" indicates that our divergence on the subject discussed is not great, now that Mr. Hanchett concedes the desirability and necessity of "abstractions."

In regard to the wattless "reactions," I am glad to say that I had already anticipated his views to a considerable extent in another communication, to which it now seems expedient to direct attention.

After I sent my first communication, printed in your issue of Nov. 24, 1910 (pages 1244 and 1245), I also sent a letter, in French, to the editor of *l'Industrie Electrique*, which has since appeared in that journal in its issue of Dec. 10, 1910 (No. 455, pages 531 and 532). In both of these letters it was made quite apparent that I objected to the adjective "wattless" under any and all circumstances. In the French letter, however, I went a little further and discussed more substitutes for "wattless power" than I did in the English letter. The English equivalents of the substitutes which I suggested are the following: *Reactance* power, *reaction* power, *reacting* power, *reactive* power and *reactant* power. The expression *reactive* power had been suggested already by M. Brylinski in a previous communication to *l'Industrie Electrique*, and I indorsed it strongly, although I preferred *reacting power*. There is a portion of that French letter which ought to please Mr. Hanchett. I suggested using the expression *reacting power* for the *general case*, involving, as I pointed out, two *specific* kinds of "reaction," namely, one due to *reactance* and the other to *condensance* or capacity, and then using the terms *condensant* power and *reactant* power to designate the two different kinds of reaction-power. We could also, in English, use, instead of these adjectival forms, the corresponding substantival forms with a hyphen, giving *reaction*-power, *reactance*-power and *condensance*-power. Of course, the same combination would apply to watts, amperes and volts as well in either case. I am inclined to prefer the substantival forms to the others, but we could get along with either. They are all satisfactory enough from the point of view of *translatability* and *exportability*. It will be seen, therefore, that I have gone still further than "current-reactions" and "reaction-currents" by proposing a nomenclature which enables the particular *kind* of reaction to be "specified" when desired. This has been done without disregarding Mr. Hanchett's requirements that the terms used should be suitable for both practical and scientific men. The practical man who wants to consider only the "resultant" reaction can use the *general* "reaction" terms. The scientific man who wants to consider the "component" reactions can use the specific terms.

Now, as to "tangible phenomena" and their interpretation I am not yet convinced that we can improve matters by shortening the terminology. The term "reaction" may be a convenient heading or title under which very important, far-reaching, "tangible" phenomena may be conveniently *catalogued*, but that does not mean that the phenomena themselves are thereby really *explained*, no matter how "tangible" they are. It so happens, for instance, that the "tangible" current indicated by an ammeter placed in an alternating-current circuit containing considerable reactance has a portion which is so "intangible" that it does not appear at all in the indications of a wattmeter, it being in that respect "tangibly wattless." Now, the power which the wattmeter measures is one of the most tangible phenomena in that case. It includes all the factors of electrical energy, whereas the current includes only one. When we look at a phase-indicator we find tangible evidence that the current indicated by the ammeter is not altogether "tangible," and we know that although the ammeter may tell the whole truth about the resistance-heating effects of the current it is more or less "off" in regard to the "power" involved. We have to apply to its readings a sort of "coefficient of mendacity," otherwise known as the "power-factor," in order to get at the real truth in regard to the "tangible" power, which is, after all, the most important consideration. Try as we may, we cannot do away with this correcting factor, if we wish to account for all the tangible phenomena and reconcile them with each other. We must, therefore, go further than merely to catalogue the reactions. We must *segregate* them and consider them in detail. When we do this we find, much to our surprise, that many seemingly abstract and abstruse things like "power-factor" become quite "tangible."

In regard to the interpretation of Ohm's law, Mr. Hanchett gives me entirely too much undeserved credit, as he did to Ohm himself. The full discussion would occupy too much space, but a brief reference may be made to some of the points mentioned by Mr. Hanchett. The suggestion that we regard alternating currents as periodically varying direct currents is not at all objectionable, but the suggestion that we take a vectorial resultant of all the e.m.fs. does not help matters much, because it lands us in a mire of *spurious or fictitious resistances* having the remarkable property that they do not cause any ohmic loss of energy in a way which causes heat (Joule effect). This resistance would be of a kind which causes IR drop, but no I^2R loss. The modern generalizations avoid this contradiction by taking into account separately the different kinds of "reactions" which variable currents produce in the presence of reactance and condensance. Ohm only considered and formulated the relations for the *particular case* where all other "reactions" than the resistance or dissipative reactions are absent.

I find in your issue of Jan. 12 two more communications on "wattless power," one from Mr. B. Spencer Greenfield and another from Mr. John R. Carson.

Mr. Greenfield's statement that I *marvel* at the possibility of dealing with "linear forces" is a bit out of phase with the

facts. My statement made it sufficiently clear, I think, that I regard it all as quite natural, and that, if I "marveled" at all, it was at those who "strain at gnats and swallow camels." I note with interest the two different definitions of force which are given by Mr. Greenfield. It is a pity that, after going to so much trouble to present the case in such an impressive manner, he should have neglected to tell us which of the two he preferred himself. It may be very difficult indeed to define force, especially if we must give up mass as another of our cherished delusions. But, until we find something better, we must use *some* definition, provisionally or tentatively. The first one spoken of, which is certainly older than Lagrange, and perhaps even much older than d'Alembert, is the one most generally accepted. The most satisfactory form of this definition is to be found in Professor Holman's classical book on "Matter, Energy, Force and Work" as follows (page 41): "*Force.* That action of energy by which it produces a tendency to change in state of motion of bodies." This is the definition which I have used in my lectures for the last ten years. The metaphysics of this definition are given quite fully in the book.

The second definition given by Mr. Greenfield would be older still than the first one if it really dated from Newton or Galileo; but in reality it is altogether *ex post facto,* so far as they are concerned, because it is purely a modern—indeed, very modern—*academic* definition, setting forth what we *now consider* must have been *meant* by Newton. It is doubtful if Newton himself would recognize his "child" when "thus clothed in "quaternion garb." There is no doubt that, practically, Newton considered forces to be agencies causing *linear* attraction or repulsion, and pulling or pushing effects, even though he *measured* them in terms of "fluxions" of momentum.

Even if it be true that mass is another figment of the imagination, or another cherished delusion, we need not on that account give up the foregoing definition of force, for the very good reason disclosed in my previous letter—namely, that the practical results which we can obtain by the use of the *hypothesis* of mass are just as real and useful and tangible as if mass were really a fact instead of an "abstraction" or a "coefficient."

Mr. Greenfield's criticism of my use of the term "force-factor" is based upon his misunderstanding of the term. He will find a definition of the *kind* of "force-factor" which I mean in the introduction to the American edition of Latour's "Induction Motor." After reading what I said there on the subject he will understand that his "mass-factors" and "acceleration-factors" are merely *particular kinds* of "force-factor." In my lectures on electric train movement I have, in fact, for many years habitually described them as such.

The reasoning about the "reactions" which cannot be found "in the wire" is similar to the reasoning about the assets of a corporation which cannot be found "in the bank." The wire and the bank both show a differential or net result only. The reactions and the assets can both be "located" if we look for them in the right way, as well as in the right place, using our "reason" as much as our perceptive faculties, or, in other words, using all our *sense* as well as our *senses.* They may be "there," even though we do not "see" them at first glance.

Regarding Mr. Carson's communication, I may say that I agree with him on every point. He did not, however, make the most of his argument about the complex character of the "reactions" involved, for the simple reason that his "standard equations" are not the most general forms. The most general form of electrodynamic equation comprises one more term, making three quantities, on the right-hand side, representing three kinds of reactions, namely, inductance, capacity and resistance reactions, which, in the case of line-transmission "reactions," are not negligible, and make the problem of separating the reactions a much more difficult and complicated one.

New York. C. O. MAILLOUX

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Starting Synchronous Motors and Converters.—O. STEELS.—After some introductory notes on some points of the theory of starting synchronous motors and converters the author discusses the practical methods of starting operation in substations. Substations with induction motor direct-current generator sets are first discussed, then substations with synchronous motors and finally substations with converters. The author deals especially with the practical use of the synchronoscope in starting.—*La Revue Elec.,* Dec. 15.

Windings.—G. E. MILLER.—A continuation of his long illustrated serial on the windings of dynamo-electric machinery. In the present instalment the author describes the method of determining the proper shape of a common form of armature coil, namely, a diamond-shaped coil.—*Elec. Journal,* January.

Induction Motor.—J. FISCHER-HINNEN.—An English translation with illustrations of his recent German paper on probable developments of asynchronous motors. The original paper was abstracted at some length in the Digest.—Lond. *Electrician,* Dec. 30.

Lamps and Lighting.

Firefly.—H. E. IVES.—An account of a further experimental investigation in which the spectrum of the firefly radiation was studied from the ultra-violet at 0.2 μ to the infra-red at 1.5 μ. Photography was employed for the ultra-violet and visible regions, the extinction of phosphorescence for the infra-red. The only radiation found is the band at 0.57 μ previously investigated. Apparently none of the same order of magnitude exists elsewhere in the region studied. The abdominal skin of the insect being shown to be transparent certainly as far as 3 μ, there remains for investigation the interval from 1.5 μ to 3 μ; all beyond 3 μ is called "body heat." That all beyond 3 μ is merely low-temperature radiation still, of course, lacks experimental proof. The light of the firefly was investigated for the properties of true phosphorescence and found to respond to none of the characteristic tests, such as dependence upon previous exposure to light or excitation by long waves. The light appears to be under the control of the insect. The results of the present investigation render still more probable the belief that the firefly produces only visible radiation of high efficiency. There is no evidence that the light is due to anything other than a true production of light by some biochemical process, which, as Langley remarks, "we know nothing to prevent our imitating successfully."—*Phys. Review,* December.

Generation, Transmission and Distribution.

Direct-Current, High-Tension Series Transmission.—The Compagnie de l'Industrie Électrique et Mécanique, of Geneva, is at present increasing the equipment of the transmission line between Moutiers and Lyons, which is worked on the well-known Thury system. The original station at Moutiers contains five generating sets, each with an output of 1600 hp. Each set consists of two double machines coupled to a turbine and supplies a constant current of 75 amp at 14,400 volts. The total rating of the generating station is 8000 hp, of which 6400 hp at 57,000 volts is transmitted to Lyons—that is, a distance of 110 miles—over two wires 0.36 in. in diameter. A three-phase line runs parallel to the direct-current system. At Lyons the line current drives eight 725-hp motors, six of which work generators for supplying energy to the Lyons tramways.

The other two drive alternators in another substation. The excellent results which have been obtained from this line during its four years' working, from the point of view of simplicity, regularity, safety and ease of upkeep, have determined the supply company to carry out the following extensions: The erection of a new station at Bridoire (Savoy) which will contain four 2000-hp generators supplying a current of 150 amp at 9125 volts; the erection during 1911 of a station at Bozel (Savoy) of three 4000-hp machines supplying 150 amp at 18,250 volts; the installation at the Vaulx-en-Velin substation at Lyons of five motors of the same type as the generators, each with a rating of 1730 hp. The present line and apparatus will also be modified to make it capable of taking 150 amp. The total rating of the new system will be 28,000 hp and the three stations coupled in series will transmit 150 amp at a pressure of 127,000 volts. This voltage will, however, not be attained under normal working conditions, as owing to the lack of water all the sets will not be able to work together on full load.—Lond. *Electrician,* Dec. 30.

Gas-Power.—E. D. Dreyfus.—A paper on some pertinent features relating to gas-power. The author gives data on natural gas, by-product gas and producer gas, and discusses the relative costs of gas plants and steam plants. He then discusses briefly the types of gas engines and their regulation, also the types of gas producers and maintenance cost. Gas-power in this country to-day is estimated to represent an aggregate of over 475,484 hp, involving the following types in the order of their approximate importance: Blast-furnace gas, 31 per cent; natural gas, 43 per cent; producer gas, 22 per cent; illuminating gas, 3 per cent; coke-oven gas, 1 per cent; distillate, oil and gasoline, 0.1 per cent.—*Elec. Journal,* January.

Electricity in Textile Mills.—L. Crouch.—The first part of an article on recent developments in the electrification of textile mills, giving notes of four groups of American textile mills representing a total rating of 17,000 kw, driving some 528,000 spindles and 19,400 looms. The present instalment deals with the Pacific mills in Lawrence, Mass. The article is to be concluded. In another article the electric equipment of the Ray mills of Stalybridge is described.—Lond. *Elec. Review,* Dec. 23.

Water-Power in Austria.—H. Duell.—The first part of a paper on the utilization of the water-powers in the Austrian Alps, where 1,500,000 hp are available for development. In the present instalment the author deals especially with the water-powers of northern Tyrol and gives details of projects with estimates of cost.—*Elek. u. Masch.* (Vienna), Dec. 18.

Power Station.—Simonsen.—The conclusion of his extended paper on the new Reisholz power plant of the Rhenish-Westphalian electricity works. In the present instalment the author deals with the particular method of the water supply from the Rhine River to the condensers and with the arrangement of the switchboard.—*Elek. Zeit.,* Dec. 22.

Traction.

Paris.—A. Reisset.—A profusely illustrated description of the Nord-Sud underground railway of Paris. It is operated by a three-wire system at 2×600 volts. An overhead wire forms the positive outer (+ 600 volts); a third-rail, the negative outer (— 600 volts). The rails form the neutral wire.—*La Lumière Elec.,* Dec. 24.

Installations, Systems and Appliances.

New Tariff.—A. Soulier.—A discussion of the recent proposal of Prof. Riccardo Arno, who wants the consumer to pay not only for the real power $ei\cos\theta$, but also at a lower rate for the "wattless power." He proposes to use a meter which measures $ei\cos\theta$ plus the nth part of the difference between apparent power ei and real power $ei\cos\theta$, where n is a conveniently chosen figure (for instance, 3). The "complex charge" measured by the instrument is, therefore,

$$P = ei\cos\theta + \frac{ei - ei\cos\theta}{n} = \frac{ei}{n}[1 + (n-1)\cos\theta]$$

This complex charge can be measured very easily by a simple adjustment of an ordinary electrodynamic meter. A phase difference is produced between the flux of the shunt circuit and the potential difference at the terminals of the circuit. For instance, for $n = 3$ Arno produces a phase difference $\theta = 5°$. In induction meters, in which θ is usually 90°, Arno makes $\theta = 95°$. The instrument thus becomes practically an exact integrator of the "complex charge" for values of the power-factor between unity and 0.8. The fairness of such a tariff is pointed out, although the difficulty is recognized of making the customer see the justice of a meter which is made to read wrong so as to indicate more than the real power.—*L'Industrie Elec.,* Dec. 25.

Control of Electric Winding and Hoisting Engines.—E. Rosenberg.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author discusses the general features of the different systems of electric winding in mines and especially the control apparatus. He deals with the Ward-Leonard system, the rheostatic control of direct-current motors, the rheostatic control of induction motors, the use of the direct-current motor as a dynamic brake and the use of induction motors with direct-current excitation as dynamic brakes. In the latter case it is impossible to employ at the same time the combined effort of the brake and the motor, say, working with a counter current, and it requires some special switching arrangement for stator as well as rotor. The author finally deals with the eddy-current brake. Such brakes behave differently if copper disks or cast-iron armatures are employed. In the formr case the torque increases with speed, reaches a maximum and then falls again. On the other hand, with eddy-current brakes with cast-iron armatures the torque always increases with increase in speed. An account of the discussion whch followed is also given. W. Cramp mentioned the use of an induction motor with a variable number of poles. The only objection to the use of the induction motor as a brake seems to be that without counter current it is applicable only for speeds a little over synchronism. If it were so arranged as to have the number of poles changed it might be used as a brake down to the speed corresponding to the largest possible number of poles; or if the winding of the motor were arranged so that it could be connected in cascade, this would enable perfect control to be obtained when running as a motor with a very wide range of regenerative braking. Rosenberg thought the chief objection to this scheme with large directly coupled winding motors to be the great number of poles required and the deterioration in performance which such an arrangement of stator and rotor coils would give even at full speed.—Lond. *Electrician,* Dec. 30.

Switchboard.—H. W. Clothier.—The conclusion of his paper presented before the Newcastle Section of the (British) Institution of Electrical Engineers on switchgear and the isolation of faults on energy-supply systems. In the present instalment the following subjects are dealt with: Leakage protection, protective gear arrangements generally, generator protection, busbar protection, feeder protection, trunk main and high-tension feeder protection, combined balance and overload protection on high-tension networks, tail-end protection, transformer protection, elimination of potential transformers for protective systems, simplest equipment of automatic panel, protection from shocks and fire, and armored switchgear.—Lond. *Electrician,* Dec. 30.

Determination of the Steps of Starters.—H. Zallud.—A description of a simple method for determining the number of steps of starters for shunt motors and of rotor starters. He uses a logarithmic paper, very little calculation being required with his method.—*Elek. u. Masch.* (Vienna), Dec. 25.

Low-Tension Switches.—Henry.—An illustrated description of recent improvements in the design and construction of low-tension switches and circuit breakers.—*L'Industrie Elec.,* Dec. 25.

Electrophysics and Magnetism.

Discharge of Electricity Through Gases.—R. F. Earhart.—An account of an experimental investigation of the effect of

temperature on the discharge of electricity through gases. Potentials required to produce luminous discharge from 22 deg. to 600 deg. depend merely on the mass of gas between the electrodes. Potentials required to maintain a discharge in air do not fall below 345 volts until temperatures approaching 1000 deg C. are reached. The minimum energy required to ionize a gas by collision depends to a very slight extent upon the temperature of the gas for temperature less than 1000 deg.—*Phys. Review,* December.

Resonance Without Damping.—F. EMDE.—When an oscillation system without any damping gets into resonance with an external periodic force the amplitudes of the forced oscillations become infinitely large. The author proves this by first giving the equations for a small amount of damping and then passing over to the limiting case in which the damping is zero.—*Elek. u. Masch.* (Vienna), Dec. 25.

Analogies Between Mechanical and Electrical Phenomena.—K. WESSELY.—A mathematical article in which the author first shows how to overcome a certain difficulty in deriving the transformer equation from Lagrange's mechanical equations of motion and then describes mechanical analogies of two generators working in parallel and of three generators working in parallel. —*Elek. u. Masch.* (Vienna), Dec. 18.

Principle of Relativity.—S. J. BARNETT.—An account of experiments on the question of the motion of the ether in a steady electromagnetic field. The result appears to favor decidedly the principle of relativity.—*Phys. Review,* December.

Units, Measurements and Instruments.

Units of Thermal Resistance and Conductance.—C. HERING. —The author supplements his former article by further discussion of his new units of the thermal ohm and mho and by a table of conversion factors connecting these with other units. A table of the resistivities and conductivities of various refractory materials in these new units is added with a numerical example on the heat conduction through furnace walls.—*Met. and Chem. Eng'ing,* January.

Direct-Current Transformer.—At the recent exhibition of the (London) Physical Society of instruments and apparatus a

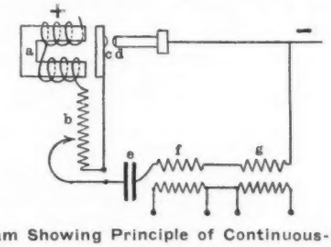


Fig. 1—Diagram Showing Principle of Continuous-Current Transformer.

transformer for the production of high-frequency alternating current from 100-volt or 250-volt direct current of Leslie Miller was shown. This instrument has been primarily devised for cautery work, for lighting low-voltage lamps, etc. By connecting the transformer to direct-current supply mains a comparatively large secondary current can be obtained from only a small primary current. Thus, on a 200-volt continuous-current circuit with a consumption of 0.5 amp a secondary current of 0.8 amp can be obtained for a cautery. The arrangement is shown in Fig. 1. In the main circuit *a* is the electromagnet, *b* a resistance, *cd* hammer and screw of break The shunt circuit comprises part of resistance *b,* the condenser *e,* and the primary windings of the transformer *fg.* The instrument comprises a small electromagnet, wound with fine wire, having a light armature pivoted in front of its poles and arranged so that it "makes and breaks" the primary current in the same way as the armature of an electric bell. Connected between the contact points are a condenser of 3 mfd or 4 mfd capacity and the primary winding of a small alternating-current transformer. The electrical energy in the shunt circuit is thereby transformed to a low pressure and a current of the required magnitude is obtained. The secondary current is adjusted by altering the position of the iron core of the transformer. An efficiency as high as 80 per cent is claimed.—Lond. *Electrician,* Dec. 30.

Cooling Curves.—At the recent exhibition of the London Physical Society there was shown a recalescence curve-tracer of H. Brearley, of Firth College, Sheffield, which is a semi-automatic device for taking, by the aid of thermo-couples, cooling curves. The specimen is heated in a small tubular furnace connected in series with a regulating rheostat and the electric supply main. The thermo-couple, placed in the specimen, has its cold junction joined through a series resistance to an Ayrton-Mather galvanometer, of the Cambridge Company, the sensitiveness of which can be regulated. The light from a Nernst lamp is reflected by the galvanometer mirror on to the scale, which is part of the Brearley apparatus proper; the scale is graduated in millimeters and fixed 1 m from the galvanometer. The apparatus consists of a drum and a sliding carriage supporting two pointers, mounted the one above the other; the upper pointer is fixed, the lower one carries the depressible pen. An electromagnet on the carriage presses the pen against the drum once every second. The observer, who sits in front of the instrument and turns a handwheel at the end of a long horizontal screw, makes the fixed pointer follow the light spot on the scale. The pointer thus marks the position of the reflected ray every second. The armature of the sliding carriage is energized from a storage battery through the intermediation of a clock which causes the pen to be attracted once every second. The drum is turned through a rack-and-pinion device; it makes one revolution in ten minutes, and the card has a length of 360 mm, so that a very large scale is secured for a range of probably a few hundred degrees Centigrade.—Lond. *Eng'ing,* Dec. 30.

High-Voltage Transformer.—A note on a transformer of German make for raising the e.m.f. from 1040 volts or 2080 volts to 500,000 volts. There are two low-tension coils, each designed for 1040 volts. On each of the two cores there are twenty-eight high-tension coils, each consisting of 377 turns, so that the e.m.f. per turn is 24 volts. The 500,000-volt sparks between the secondary electrodes bridge an air-gap of 1.3 m (4¼ ft.).—*Jour. du Four Elec.,* Dec. 1.

Calorimetry.—W. P. WHITE.—The author describes in detail a calorimetric system in which all conditions affecting the calorimeter temperature are, as far as possible, definite and measured, and in which as a result errors once serious are made negligible, computation is often simplified and an increase in effective thermometric accuracy can be secured. The apparatus was designed for the determination of specific heats, especially at high temperatures, by the mixing method. Descriptions are given of two calorimeters designed for effectiveness in stirring. For the electric furnace the type with internal platinum winding is employed. It permits the attainment of a higher temperature and diminishes the slag between coil and chamber, thus increasing the rapidity and the exactness with which a constant temperature may be reached and maintained. For measuring the calorimeter temperature copper-constantan thermo-elements are used, and for the furnaces platinum-rhodium elements, while the potentiometer installation has been further developed, especially with respect to equipotential leakage shields to protect against leakage in the potentiometer system.—*Phys. Review,* December.

Calorimetry Calibration.—The results of accurate tests of the two calorimeters mentioned in the preceding abstract by the electrical method. The electrical method is accurate and convenient if an adequate storage battery and an accurate signal clock are available. An automatic switch, which starts and stops the heating current in obedience to electric signals from a chronometer, is an advantageous substitute for a chronograph. The chief result of these tests is that the average accidental error of a complete calorimetric determination has been reduced to about one part in 30,000. The average accidental temperature error was brought below 0.00025 deg. This is

practically a perfect performance for the multiple thermo-element used as a thermometer.—*Phys. Review,* December.

Thermo-Pile.—B. J. Spence.—The author has designed a very sensitive thermo-pile by employing alloys of bismuth and 5 per cent tin and bismuth and 3 per cent antimony. A single pair of junctions of these alloys gives a thermo-electromotive force of 120×10^{-6} volt per degree difference of temperature over a wide range of average temperatures—that is, between hot and cold junctions. The arrangement is described in detail. This peculiar type of thermo-pile has overcome to some extent the usual objections applied to thermo-piles in general, namely, lack of sensibility and sluggishness. It has a sensibility superior to the best bolometers and lacks the annoying unsteadiness of the bolometer due chiefly to batteries. It possesses a slow drift, which likewise is common to the bolometer, and is more sluggish than the bolometer.—*Phys. Review,* December.

Telegraphy, Telephony and Signals.

Microphones and Long-Distance Telephony.—Béla Gátl.—The author gives a review of former investigations made by others and more recent ones made by him on the current waves in microphones. The simplest way of studying the problem is to produce in front of the microphone a single tone and to measure the pulsatory current set up in the secondary coil of the telephone transformer. The best sound producer for such purposes is that due to Stern. In the author's experiments he used the barretter for measuring the current. The results of tests of a number of microphones of Hungarian make are given in diagrams in which the abscissas represent the number of oscillations of the sound waves, and the ordinates the strength of the current measured in millionths of an ampere with the barretter in the secondary circuit, when there is electric resonance. It is found that the microphones of a central battery system are the best, for while the fundamental tone of microphones used in other systems is low (about 600), that of the common battery microphone is in the neighborhood of 800. Considering that the number of vibrations of the ordinary vowel sound *a* long exceeds 900 (exclusive of the harmonics, the frequency of which is higher), it would be supposed that a microphone was better when it had a high fundamental tone, so that it would better render the higher sounds. To raise the fundamental tone of the microphone and to arrange it to carry a high current without heating use may be made of the arrangement designed by the Swedish engineers Egner and Holmstrom, whose microphone is shown in Fig. 2. The diaphragm is large and is tightly stretched by the device shown. A higher fundamental tone is thus obtained. When speaking into this instrument the higher tones of the voice remain sufficiently clear to be understood, even over a long line. It is thus possible to reach much greater distances by this aid than heretofore. However, as the principle of diaphragm tension is well known and could not, therefore, be patented, the inventors had recourse to the theory of points of junction of the diaphragm, and on the strength of this the patent was obtained. The cooling of the microphone is good. The inventors claim that they use a high current (1 amp), which increases the good results. At present more than 5,000,000 microphones are in use in the world, and the number will be 10,000,000 in a few years. It is desirable to improve the existing microphones so that they can carry one or more amperes. The necessary improvement can be effected by rather simple means, namely, by using a cooled microphone. This, in fact, serves fairly well for distances up to 2500 km (1500 miles) on a 4-mm (0.16-in.) copper wire, not only on a clear line, but also where outside disturbances take place. Some fundamental points of long-distance telephony are then discussed and wave forms are reproduced of the vowel *a* taken by oscillographic means. Like other apparatus, the long-distance high-current microphone has its drawbacks. The strong current in the line sets up a considerable induction in the neighboring circuits, so that the voice can also be heard in these latter lines. At the transmitting end the current passes through the receiver so that the speaker's voice is heard very loudly. This gives a somewhat disagreeable effect, at least at first. A remedy can no doubt be found for this, however. In any case the passage of the outgoing current through the resistance of the receiver causes a considerable lowering of the tension, which should be avoided. Another use to which the high-current microphone might be put is to operate a typewriting machine, using the characteristic waves for each letter of the alphabet. Marconi has already proposed this idea. The new microphone has also been tried for submarine bell signaling, and it should greatly increase the range of such signals.—Lond. *Electrician,* Dec. 30.

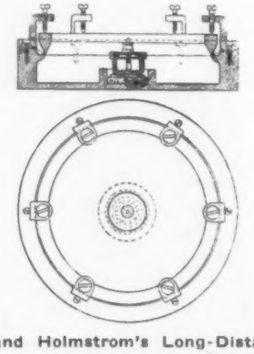


Fig. 2—Egner and Holmstrom's Long-Distance Microphone.

Wireless Telegraphy.—Brenot.—An illustrated article on the use of wireless telegraphy for the determination of differences of longitude.—*La Lumière Elec.,* Dec. 24.

Wireless Telephony.—C. O. White.—An illustrated description of the new commercial wireless telephone system of Dubilier.—Lond. *Electrician,* Dec. 30.

Electrochemistry and Batteries.

Electric Steel Furnace.—J. Harden.—An illustrated description of a new electric furnace for steel making and refining. It is a combination of an arc and a resistance furnace. For operation with three-phase currents three electrodes are used at the top which heat the bath, but the bath is also heated by the Joulean heat of currents passing through the bath between pole plates such as are used in the Roechling-Rodenhauser furnace.—*Met. and Chem. Eng'ing,* January.

Cyanamide.—An article by J. W. Beckman in which he points out that the term cyanamide is now used in three different senses, but that its use should be restricted to the chemical compound H_2CN_2, while the commercial fertilizers may be called lime-nitrogen and lime-nitrogen compound, etc. The same issue contains a long paper by J. C. Clancy on his process of using cyanamide with electrolysis in the metallurgy of gold.—*Met. and Chem. Eng'ing,* January.

Electromagnetic Separation.—E. Oppen.—A paper discussing the use of electromagnetic separation in foundries, especially for cleaning the molding sand, for separating metallic iron from cupola slag and for the recovery of iron in general. Various designs of separators of German make are described and illustrated.—*Stahl und Eisen,* Nov. 9.—Some details of the design of separators are discussed in two letters by G. Rietkotter and E. Oppen in *Stahl und Eisen,* Dec. 7.

Miscellaneous.

Asbestos.—H. R. Edgecomb.—A discussion of the production and uses of asbestos under the following heads: Origin, varieties, physical characteristics, geographical distribution, production, mining, preparation, general uses and uses for electrical insulation and its limitations.—*Elec. Journal,* January.

Swiss Electrical Society.—An account of the annual meeting held in November in Schaffhausen of the Association of Swiss Electricity Works and of the Swiss Electrical Society. There was a discussion on the revision of the factory laws in Switzerland, a report of the testing bureau of the society, and also reports of various committees.—*Elek. Zeit.,* Dec. 22.

BOOK REVIEWS.

NOTES ON THE GRAPHICS OF MACHINE FORCES. By Robert C. H. Heck. New York: D. Van Nostrand Company. 42 pages, 39 illus. Price, $1.

The author has selected a number of ordinary mechanisms, such as journal friction, belt transmission, chain and rope resistances, in order to show the utility of graphics in dealing with problems connected with them. The suggestiveness of the work is a valuable feature.

ELEMENTARY MECHANICS. Including Hydrostatics and Pneumatics. By Sir Oliver Lodge. New York: D. Van Nostrand Company. 308 pages, 107 illus. Price, $1.50.

The first edition of this elementary manual from the pen of its distinguished author appeared in 1895 and was followed by a "new edition" in 1897. The present one is identical with the revised edition of 1897. The subjects are expounded in a clear and thorough manner, and the student who has mastered the treatise will find that he has an excellent preparation for the study of physics and analytical mechanics. The numerical examples appended to the chapters and the examination papers at the end of the volume are a commendable feature of the work.

CABLE FAULT LOCALIZATION GRAPHS IN PRACTICE. By Edward Raymond Barker. London: H. Alabaster, Gatehouse & Company. 68 pages, 24 illus. Price, 25 shillings.

The location of faults in submarine cables has long been the subject of study by the author and this last publication consists largely of a reprint of a series of articles which appeared in the *Electrical Review*, London. The present book gives results of experience with the author's calculation-board and discusses a large number of graphs taken from actual practice.

DIE TRANSFORMATOREN. By Dr. Gustav Benischke. Braunschweig: Friedrich Vieweg & Son. 220 pages, 228 illus. Price, 10 marks.

The volume is devoted to the theory and practice of transformers in alternating-current engineering. The modes of operation, construction, testing and designing of transformers are considered from the engineering standpoint and particularly in relation to transformers operating on lighting mains. Some excellent illustrations of types of transformers in current German use are appended, some of them indicating the methods of construction and assembling.

The engineering theory of the subject is discussed mathematically, but the mathematical treatment is not very difficult. The chapters relate successively to the introduction, the mode of transformer operation, their construction, their heating and loading, their connections and special applications, tests, and design. The volume will be of special interest to students of electrical engineering acquainted with the German language and to practising engineers interested in German methods of transformer construction and testing.

MOTORMAN'S PRACTICAL AIR-BRAKE INSTRUCTOR. By George R. Denehie. Chicago: Frederick J. Drake. 280 pages, 151 illus. Price, $1.50.

Although the title of this book confines the scope to air brakes other forms of brakes, such as electric and hand brakes, have also been allotted a space in proportion to their importance. The book is mainly devoted to the description of the construction and operation of different systems of power brakes, the explanations being accompanied by well-chosen illustrations, a large number of which are printed in colors. At the end of each section is given a list of questions and answers intended to clinch the important points covered in the body of the section. The subject of braking is treated in a general way and instructions are given for the operation and care of braking apparatus.

New Apparatus and Appliances

PORTABLE PRINTING ATTACHMENT.

The Minerallac Electric Company, 1004 West Van Buren Street, Chicago, has developed a new form of the Chicago printing attachment which is portable. The new outfit has been developed to meet the demands for a self-contained instrument for testing purposes to determine load factor for different periods, demand at different hours of the day and other information of this kind. The complete set consists of one of the company's standard type C printing attachments, one contact-making clock and one battery of dry cells, all assembled and protected in a neat oak carrying case. With this form of attachment a test on a customer's line is a simple matter, all that is required being the connecting of the three binding posts on the top of the attachment to the watt-hour meter register.

QUARTZ-TUBE MERCURY-VAPOR LAMP.

Constructive details of a form of quartz-tube mercury-vapor lamp recently placed on the market by the Brush Electrical Engineering Company, 37 Strand, W. C., London, England, are shown in the accompanying illustrations. Use is made of quartz rather than glass on account of the high temperature reached by the mercury vapor, namely, 3000 deg. Fahr. The specific light output increases at a rapid rate with increase in the temperature and at the temperature maintained in the quartz-tube mercury-vapor lamp reaches about 4 cp per watt. The light is deficient in respect to certain of the rays—but to a less extent than is that from the lower-temperature glass-tube

Fig. 1—Exterior View of Quartz-Tube Mercury-Vapor Lamp.

mercury-vapor lamp—and hence the lamp is not suitable for use where color matching is of prime importance. It gives forth much violet and ultra-violet light, but these rays are

properly subdued by means of the opal glass globe which surrounds the mercury-vapor tube. The lamp is especially well suited for the lighting of outdoor areas and industrial premises where the color of the light is of less importance than its quantity and distribution. The lamp here illustrated is made in two sizes, giving from 1800 cp to 2500 cp at either 110 volts or 220 volts. The lamp is so constructed that the quartz tube can be renewed at any time. A useful life of 1000 hours is guaranteed for each tube whether installed initially in a lamp or subsequently for renewal.

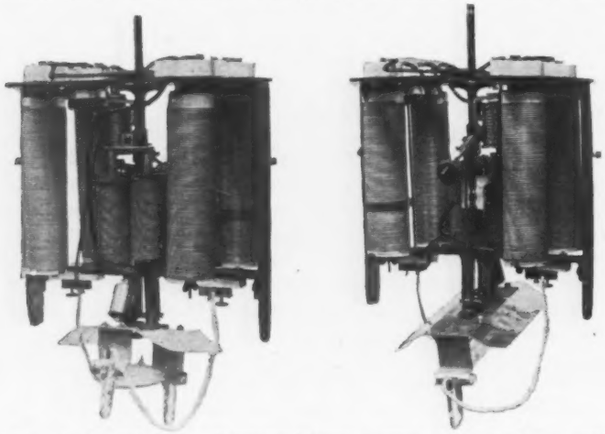


Fig. 2—Quartz-Tube Mercury-Vapor Lamps with Casings and Globes Removed.

AN INTERRUPTER FOR RAILROAD TELEPHONE WORK.

A circuit interrupter designed especially for railway telephone service has been placed on the market by the Western Electric Company. This interrupter is especially adapted for use in block towers where the operators are so busy that they do not have the time to call other stations by means of a hand generator. It is also especially adapted for use on yard lines where several telephones are connected to the same pair of wires.

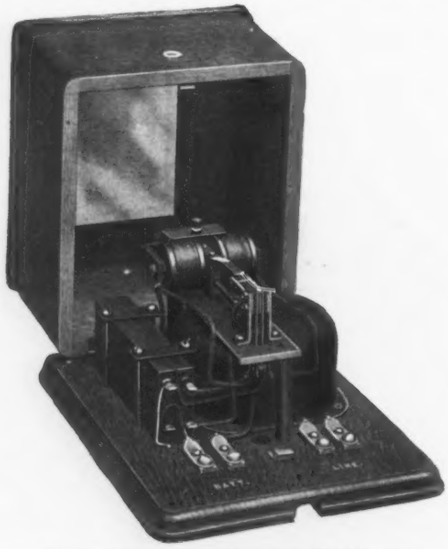


Fig. 1—Open View, Showing Mechanism.

The interrupter, a view of which is shown in Fig. 1, is intended to be mounted normally upon the wall in a vertical position in the same manner as a telephone set. The set is inclosed in a neat, well-constructed oak cabinet provided with a hinged cover. This cover is provided with a glass window through which the operator of the mechanism can be observed when the cover is closed. The mechanism is mounted upon the base of the cabinet and is readily accessible for adjustment, test and inspection.

The interrupter is operated by means of a key or push button which closes a battery circuit containing from four to eight dry cells. The number of cells necessary depends upon the number of bells it is desired to ring. Five dry cells will operate effectively fourteen 1000-ohm ringers or sixteen 2500-ohm ringers on a line of 500 ohms resistance, an equivalent of about a thirty-mile metallic circuit of No. 12 copper wire.

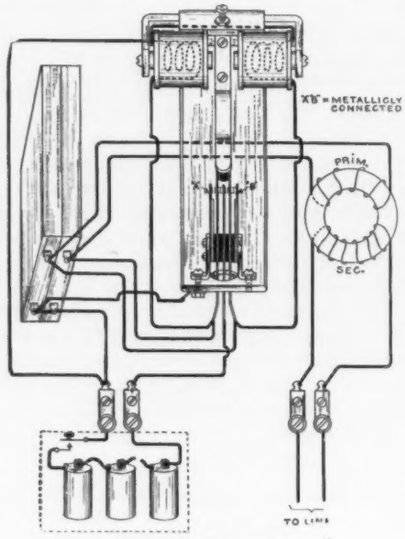


Fig. 2—Circuit Diagram.

The interrupter is so adjusted that it responds at once when the key is pressed, thereby closing the battery circuit. This arrangement insures a very economical energy consumption, as the interrupter is only in action when the battery circuit is closed. The mechanism is practically noiseless and sparkless. All circuit contacts are of platinum. Although the mechanism is very sensitive, it is built in a substantial manner which insures long service and low maintenance.

The circuit diagram illustrated in Fig. 2 shows the simplicity of the circuit and the ease with which it can be connected.

FLAMING-ARC LAMPS FOR WHARF LIGHTING.

The capital invested in the modern ocean greyhound is so great, the maintenance so large and the time of actual service before the vessel is considered obsolete so small that in order to obtain any return on the investment the time spent in port must be a minimum. For that reason stevedores, longshoremen and coal shovelers work day and night unloading and loading the vessel with freight and fuel. This night work requires good artificial lighting, and for single-story piers and those of two stories having ceilings of sufficient height the flaming-arc lamp, because of its economical operation, great brilliancy and penetrating power, has proved a very satisfactory illuminant for lighting these large semi-open areas. An excellent example of this class of illumination is afforded by the new pier of the Fabre Steamship Company at the foot of Thirty-first Street, Brooklyn, N. Y. This pier is the largest in or about New York, being 1476 ft. long, 150 ft. wide and 35 ft. high. Being only one story high, it is lighted during the day by means of skylights and whatever light comes in through the open doors. In fall and winter it becomes necessary to turn on the arc lamps as early as 4 o'clock. The present lighting system, which has been in operation about three months, consists of 24 Western Electric Hawthorn flaming-arc lamps, 22 of which are hung inside the building and the other two outside the building, one at either entrance. The lamps

are hung in two parallel rows and about 120 ft. apart, the distance between the rows being 50 ft. Electrical energy is taken from a 2200-volt, three-phase, 60-cycle circuit of the Brooklyn Edison Company, brought into the building near the front entrance and stepped down to 115 volts by a transformer. From the transformer a circuit is run the length of the building. The entire lighting system is controlled by five boxes, so wired that three of them control four lamps each and two of them six lamps each, the lamps being connected two in series. The pier is long enough to berth and load three vessels at once, in which case all of the lamps would have to be burning. This seldom happens, however, a dozen lamps being a fair average load. One of the obstacles met with in lighting the pier is the elevated platform shown in the photograph. It was thought at first that this platform, which extends the length of the pier and is used for the convenience of passengers, would throw such a heavy shadow as to make the proposed plan of hanging the lamps impracticable. It has been found, however, that while this platform is over 8 ft. wide and but slightly below the level of the lamps the latter throw such a penetrating light as almost to overcome all shadows.

View of Pier Illuminated with Flaming-Arc Lamps.

The Fabre Steamship Company operates a line of ships between Naples, Marseilles and New York, and carries principally olive oil, olives, wines, raisins, nuts and grapes. The last three are extremely bulky and when unloaded are often piled almost ceiling high. If any other illuminant but flaming arcs was used it would not be possible to hang it high enough to render it impossible for the cargo to cut off a great deal of the light.

INDUCTION WATT-HOUR METER.

The accompanying illustrations show the latest form of watt-hour meters, represented in the type C meters built by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The meter operates on the induction principle, the driving torque of the meter resulting from a shifting magnetic field acting on an aluminum disk. The shifting field is produced by the line current in a low-resistance series coil and current in a highly inductive shunt coil connected across the line. The coils are mounted on a laminated iron magnetic circuit of special design.

The design of the electromagnetic circuit is shown in Fig. 1. It will be noted that the circuit is closed on itself and therefore self-shielding, making the meter independent of stray fields. The arrangement is also such that most of the flux produced by the voltage coil passes through the gaps *FF*, only a leakage component across the gaps *ADC*, while *ABC* combines with the series flux to produce rotation. This feature renders the meter accurate over a wide voltage range by reducing the effect of varying permeability of the iron at varying voltage and also prevents shunt-field damping at high voltage, a serious defect in some types of meters. The light-load adjustment loops pass through the gaps *FF* and produce sufficient unbalance between the two limbs of the voltage flux to cause a friction-compensating torque. Owing to this position of the no-load adjustment loops, however, this adjustment is entirely independent of current.

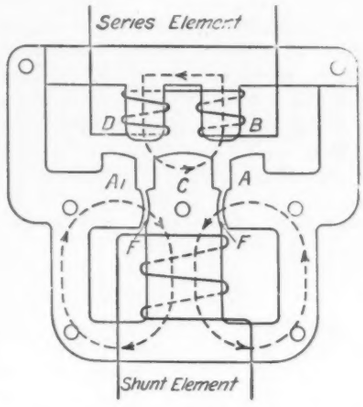


Fig. 1—Electro-Magnetic Circuit of Induction Watt-Hour Meter.

A feature of the meter is the micrometer light-load adjustment. The position of the micrometer screws at the bottom of the meter element, as shown in Fig. 2, makes them very accessible. The micrometer feature makes possible very accurate adjustments. It is claimed that the combination of freedom from current effect, possibility of micrometer adjustment and accessibility make an ideal light-load device, free from creeping and having maximum accuracy.

The positive full-load adjustment is another notable feature. The two retarding magnets are mounted on a heavy brass U-strap, the ends of which slide in machined ways in the mounting frame. This arrangement makes it impossible to twist the magnets out of alignment in tightening the clamping screws. Two clamping screws at each end of the U render the adjustment permanent in spite of shocks and jars. For mounting a highly polished and specially hardened steel ball working between two cup jewels is used. As it is impossible to make the center of gravity of the moving element

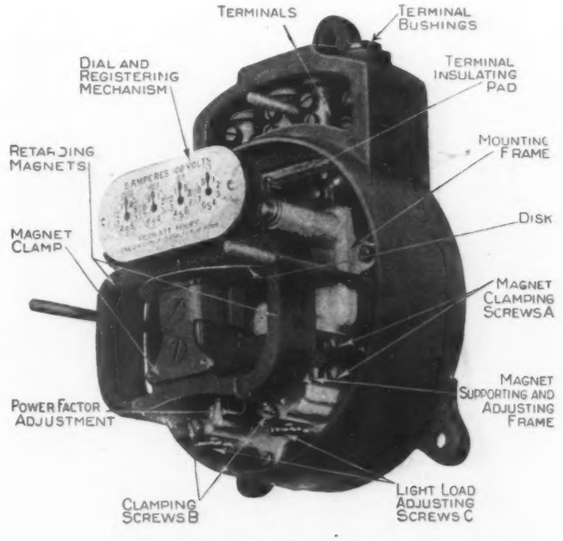


Fig. 2—Induction Watt-Hour Meter.

correspond exactly with the center of the bearing, the shaft has a very slight gyratory motion which gives a rolling action to the ball. This produces considerably less friction than the boring action of the jewel and pivot and, by presenting constantly new bearing surfaces, is stated to assure an extremely long jewel life and permanent light-load accuracy.

Permanence of full-load accuracy is assured by the special aging treatment given to the retarding magnets and by the protection afforded by an iron shield between the permanent magnets and the electromagnet, which prevents any bad effects from the heavy fields produced by overloads. The entire meter element is carried on a cast-iron mounting frame so that it can be removed from the case as a unit without disturbing any adjustment. This allows adequate inspection in case of trouble and makes all parts accessible for repairs.

The full-load torque of the meter is 42 millimetergrams per phase and the weight of the moving element is only 15 grams per phase. This gives the high ratio of torque to weight of 2.8. The lightness of the moving element further insures long life of bearing jewels. The shunt coil loss is from 1.4 watts to 1.8 watts per phase at normal voltage, and the series coils produce a drop of 0.4 volt at full load.

Every meter has a guaranteed accuracy within 2 per cent. at from 2 per cent of full load to 50 per cent overload. This permanence of the meters is stated to be so reliable that these limits can be depended on even after shipment. No adjustment is necessary at installation nor need the case be opened to remove supporting wedges or release the movement. For this reason separately sealed terminal chambers are provided for making connections, retaining the orignal seals on the meter element. This not only preserves the guarantee of accuracy, but prevents dust entering the meter at installation. The meter is built in all forms demanded by common needs.

RECTIFIERS CHARGING BATTERIES OF FIRE-ALARM SYSTEM.

The mercury-arc rectifier shown in Fig. 1 has been installed for charging the storage batteries which operate the fire-alarm

Fig. 1—Mercury-Arc Rectifier Panel.

system of the City of Sandusky, Ohio. The battery consists of four sets of fifteen cells each, chloride accumulator, and, with the present system, fifty fire-alarm boxes can be pulled at once.

Previous to the installation of the rectifier a gravity battery consisting of 108 cells operated the fire-alarm system. The new installation effects a saving of $300 per year, as cell renewals when gravity batteries were used were a large item of expense. The first cost of the new equipment, including rectifier, battery and distributing board installed complete, was

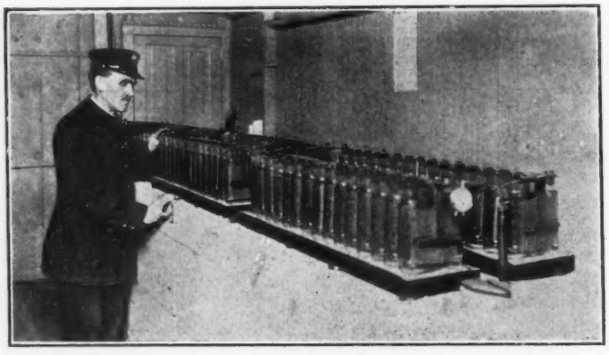


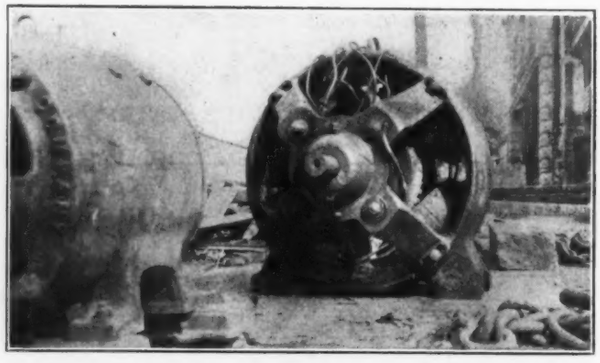
Fig. 2—Storage Battery.

$589, while the cost of energy for its operation is about $1.40 per month at a 10-cent-per-kw-hour rate.

This equipment is operating very satisfactorily and during the six months it has been in operation absolutely no trouble of any kind has been experienced with it. The rectifier panel was furnished by the General Electric Company, Schenectady, N. Y.

LIFE OF ELECTRICAL APPARATUS.

Electrical apparatus is generally considered to be less rugged than some other classes of machinery, but the accompanying illustration and description show through what severe ordeals it may sometimes pass without serious damage. The illustration shows two Bullock motors taken from the ruins of the Los Angeles Times Building. After the explosion and fire which recently destroyed this building these motors were removed from the basement, where they were lying in 5 ft. of water. The presses to which they were attached were completely destroyed and had no value except as scrap iron. The motors, however, were not badly damaged and were practically the only article of value saved from the ruins. In the adjustment of losses made by the Fire Underwriters' Association 99 per cent of the total insurance was allowed, the 1 per cent



Motors Taken from the Ruins of the Los Angeles Times Building.

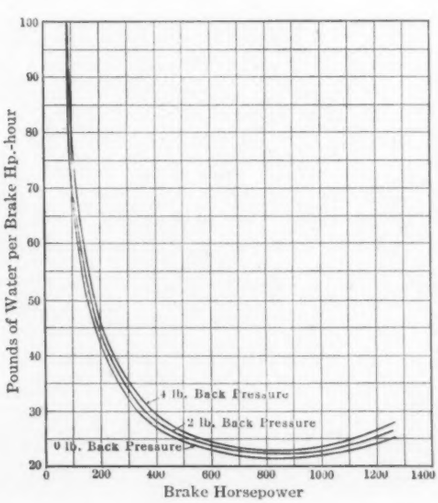
saving being based almost entirely on the value of the motors. The insulation of these was rendered useless, but the commutators, brush holders, bearings and frames of the machines were in perfect condition.

The motors attracted considerable attention and excited much comment because of the fact that they were the only pieces of machinery saved from the ruins. The larger motor is a 60-hp, 500-volt, 400-r.p.m. machine, while the smaller is a 10-hp, 450-r.p.m. machine. They are now being rewound in the shops of the manufacturer, the Allis-Chalmers Company, and will be used to drive new presses in the new building which is soon to be erected.

NEW NON-CONDENSING LIGHT AND STEAM-HEAT PLANT.

Nowadays a popular subject for discussion in connection with the design of power stations is the much-debated one of turbines vs. reciprocating engines. An example of the adoption of the latter in preference to the former is afforded by a central lighting and heating plant recently erected in Milwaukee. In this case it was considered that since the exhaust was to be used for heating and therefore the engine must exhaust against a back pressure, and it was impossible to run the engines condensing, the reciprocating type was undoubtedly better from all viewpoints than the turbine.

In this case there is a heating load in winter and atmospheric exhaust in summer because of the impracticability of obtaining sufficient water for condensing purposes. The new station is that of the Wells Power Company, of Milwaukee, Wis. It is situated in the basement of what is known as the Stevenson Building, at the corner of Mason and Milwaukee Streets, and is run in parallel with the old station in the Wells Building, a few blocks distant. These two plants supply energy within an area of about two and one-half miles in the center of the business section of Milwaukee. Electricity for lamps and motors is distributed on a three-wire direct-current system and exhaust steam for heating is sold throughout this territory. In order to prevent the heating load from outgrowing the lighting load it is the policy of the power company to accept no heating contracts without the accompanying lighting contracts.



Steam Consumption per Brake Horse-Power, 24-in. x 40-in. x 36-in. Vertical Cross-Compound Engine.

The main units for the new station, which was designed by and erected under the supervision of Messrs. D. C. & Wm. B. Jackson, engineers, of Chicago and Boston, are two 700-hp Allis-Chalmers cross-compound vertical Corliss non-condensing engines, direct-connected to 250-volt, direct-current Bullock generators of 500-kw rating each. These engines run at a speed of 100 r.p.m. and, with steam at 150-lb. pressure and exhausting against 2-lb. back pressure, will deliver an indicated horse-power on 20 lb. of steam. The accompanying curve, which shows the water rate under various conditions of back pressure, indicates the excellent economy of the units. The close proximity of the three curves is particularly noteworthy, indicating as it does but little change in economy from winter to summer conditions.

These machines are run non-condensing throughout the year, it having been decided that owing to the location of the station in the heart of the city and its elevation, the problem of obtaining condensing water in sufficient quantities offers too great an obstacle to the installation of condensers. Accordingly, as soon as the heating load drops off the engine exhaust is discharged to the atmosphere. Despite the unfavorable conditions the all-the-year-round consumption of these engines is remarkably good, averaging 20 lb. of steam per indicated hp-hour. By running the main units at or near their most economical point and taking up the fluctuations in load on the smaller engines in the old station, it has been possible to keep the general operating efficiency of the company's two plants at a very good figure. At the present time the designers of the new plant, Messrs. Jackson, are supervising the operation of the station.

RECENT IMPROVED DESIGNS OF MAGNETOS FOR IGNITION SERVICE.

Several interesting departures in magneto design from the familiar rotating-bobbin type which has so long remained standard were exhibited at the annual convention of the National Gas and Gasoline Engine Trades Association, held at Racine, Wis., Dec. 12-15. In several of these oscillating armatures have replaced the older rotating forms, while in others the armature coils have been made stationary, avoiding moving contacts and insulation problems.

A new oscillating-armature type recently brought out by the Bosch Magneto Company, New York, is shown in the diagrammatic sketch, Fig. 1. The general arrangement is similar to the standard magneto form, but the armature is designed to be rotated through an arc of about 30 deg. by a cam trip on the half-speed shaft, being returned swiftly to its neutral position when released by a pair of heavy helical springs. Besides the momentary high potential developed due to the high speed of the armature's return the armature has a double winding, a primary consisting of a few turns of heavy wire and a secondary of many turns of fine wire. At the instant of the arma-

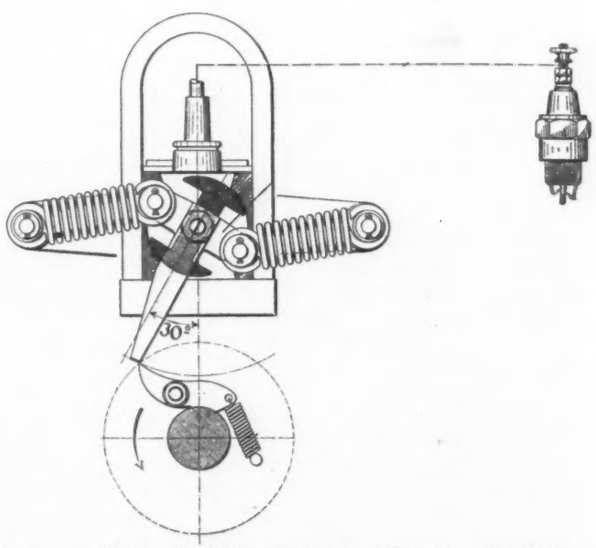


Fig. 1—Bosch Oscillating-Armature Magneto with Spring Return.

ture's return a contact breaker is arranged to open the primary circuit, thus producing a relatively high-potential transformer action in the secondary winding. The secondary terminals are led directly to the spark-plug gap.

An oscillating-bobbin magneto with spring return was also exhibited in the convention hall by the Webster Electric Company, Tiffin, Ohio. In this machine the field structure is modified into the ring type, straight-bar magnets being used. In all

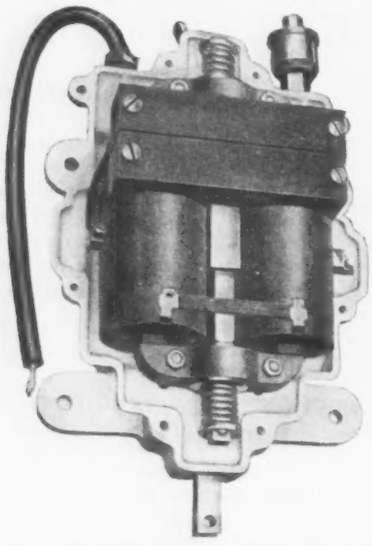


Fig. 2—Witherbee Oscillating Magneto.

of these oscillating-armature magnetos the armature is moved only during the instant of delivering its spark, energy being collected from the half-speed shaft, however, during a large portion of the revolution, preserved in the springs and then suddenly released at a high rate of work when the cam disengages and the armature is snapped back. The quality of the spark produced is thus entirely independent of the speed of the engine.

An oscillating-type magneto in which the field structure and coils are both stationary, a magnetic short-circuiting keeper being the only moving element, was exhibited by the Witherbee Igniter Company, Springfield, Mass., and is shown in Fig. 2. This magneto comprises a group of bar magnets, whose magnetic path is always closed through the two cores of the armature coils, being permanently yoked by a cross-piece of soft-iron laminations. A movable short-circuiting yoke is also applied between the cores directly below the permanent magnets, thus acting, when closed, to shunt the lines of force away from the longer path formed by the winding cores. The short-circuiting yoke or armature is operated by a driving bar whose motion is imparted by some half-speed part of the engine. The bar is also provided with a latch mechanism allowing the short-circuiting yoke to be lifted and suddenly returned by springs into contact with the cores under the magnets. The height of the lift is adjustable to correspond with the service required of the generator. The action of the momentary withdrawal of the short-circuiting yoke is thus to send a magnetic impulse through the cores of the windings, inducing in the latter a high-tension e.m.f. which is applied directly to the spark plug. The magneto operates, of course, only at the instant its output is required, and for its drive requires only any half-speed reciprocating motion.

A new rotating-armature magneto of the inductor-generator type was exhibited by the Pfanstiehl Electrical Laboratory, North Chicago, Ill., in which the armature winding is stationary, being mounted on a ring inclosing the rotating iron armature at its middle point. The magnetic circuit of the horseshoe permanent magnets terminates in four half-length pole-pieces set at 90-deg. intervals, one pair opposing each half of the rotating bobbin and being so arranged that the flux from pole to pole is first set up in one direction and then, at the next 90-deg. position, in the opposite direction along the axis of the bobbin. This alternating flux traversing the stationary armature coil at the middle point of the bobbin sets up in it an alternating e.m.f.

SOME SPECIAL FEATURES OF THE CHICAGO ELECTRICAL SHOW.

The first week of the sixth annual Chicago Electrical Show closed with a large attendance. On one day of the week, Thursday, it was asserted that 17,000 people visited the Coliseum. The week was also marked by the meetings of several electrical and allied engineering bodies under the Electrical Show roof, through the courtesy of the management. The Chicago Electric Club's regular Wednesday luncheon was held in the Coliseum restaurant Jan. 11, and on Friday the Chicago Section of the Illuminating Engineering Society met in one of the Coliseum lecture halls. The Electrical Show continues until Saturday evening, Jan. 21.

The unique estimating contest, the first prize in which is a $2,500 Woods Victoria electric brougham, continues to hold the attention and interest of every purchaser of a paid admission to the Electrical Show. The electric automobile will be awarded to the estimator coming nearest to the exact total length of the wire on the column at the center of the exhibition floor, while twelve other prizes, ranging from an electric piano player and an electric washing machine down to electric heating devices and electric irons, will be distributed among the contestants next in order of success. The column on which the bare and insulated iron and copper cable and wire is wound measures 25 ft. 3 in. to the eagle surmounting the corona of electric lamps at its cap. It is built up of four tapered spools, the lower one wound with iron wire, the next with copper, then iron and again copper, presenting alternate shining bands

Fig. 1—Roof Decoration, Open Tent and Sky.

of color on the shaft, as the bare wire forms the outer layer in each case.

The following helpful data have been prepared and are distributed to later contestants for the prizes: Bottom coil, 4 ft. 11 in., at base; wound with one layer of No. 6 B. & S. gage, rubber-covered copper cable and one layer of No. 8 wire-gage, bare galvanized-iron wire. Second coil, 2 ft. 8.5 in. at base; wound with one layer No. 8 rubber-covered cable and one layer of No. 10 bare iron wire. Third coil, one layer

No. 14 duplex rubber-covered copper wire and one layer No. 12 bare wire. Top coil, 2 ft. 3.25 in. diameter; one layer No. 12 rubber-covered copper wire and one layer No. 14 bare copper wire. Each holder of a paid admission receives a ballot entitling him to estimate on the length of wire on the column.

With the spirit of estimating contests abroad, the Chicago Telephone Company also conducted a contest to which every visitor to the show was admitted, the one estimating most correctly the total number of telephones in its Chicago territory Saturday, Jan. 14, to receive one year's telephone service free of charge.

Fig. 2—General View of the Electrical Show.

During the first week the operator of the "wireless kitchen" in the Coliseum Annex introduced several new thrills into his répertoire, one of which was to fry eggs in a frying pan resting on a cake of ice on the marble-topped table. As has been already explained, an alternating-current electromagnet was mounted under the table top, its powerful field being used to induce eddy currents in any closed conductor brought over it. The electromagnet used from 70 amp to 100 amp of 60-cycle, 110-volt current, and delivered several kilowatts to the frying pan, cooking eggs in ninety seconds through 2 in. or 3 in. of ice or other non-magnetic medium intervening. During the performances a 60-watt series tungsten-filament lamp in series with a coil of a number of turns was also brought up to full candle-power through the 264-page Jan. 5 issue of the *Electrical World* laid on top of several 1-in. slabs of slate.

For visitors to the storerooms on "Commonwealth Avenue," the exhibit of the Commonwealth Edison Company, a number of special souvenirs and booklets have been provided. "How to Avoid Using Matches" is the legend on the envelopes containing matchsafes in the form of tungsten lamps, the answer on the box being, of course, "Use Electricity." Handsome paper-clips were also provided for distribution among merchants and store owners who visit the exhibit. Several specially prepared booklets directed at this class relate to the use of electricity for window lighting and ornamental street lighting. One striking folder shows that there are 2190 hours of darkness between dusk and midnight during the year, and that if only one person per minute passes along the street the electrically lighted window will be viewed by 131,400 prospective customers in the course of the year. At the lamp-shop exhibit the handsomely executed booklet describing the downtown Electric Shop is also distributed to visitors.

Novel souvenirs distributed from the central-station exhibit of the Cosmopolitan Electric Company, Chicago, are tiny brass barrels turned out by the motor-driven automatic screw machine operating in this booth. These little barrels, measuring 13/16 in. over all, are fitted with accurately turned screw heads and when handed out each barrel contains a little folder, tightly rolled, referring to the use of central-station energy for motors. "This little barrel," reads the folder, "shows what may be done by automatic motor-driven machinery at a nominal cost. If made by hand it would cost twice its weight in gold." The Cosmopolitan company also exhibits the hoist carriage of a five-ton motor-driven crane, with a 40-in. electric lifting magnet used to handle bars of pig iron, and a motor-driven blower used to hold a rubber ball in the air over a blast nozzle.

Electric baking of bread to be given to charity is one of the interesting and creditable undertakings participated in by the Simplex Electric Heating Company, the Commonwealth Edison Company and H. H. Kohlsaat & Company, a Chicago firm of bakers. Eighty standard 1-lb. loaves are produced at a baking, demonstrating the adaptability of electric heat for baking on this large scale. The large Simplex electric oven consumes 10 kw at full heat, but after being brought to baking temperature is ordinarily operated at half heat. The oven can be heated ready for baking in thirty minutes. Cast-grid resistance elements in the lower part of the oven produce the heat, which is conveyed to the pan shelves through hot-air ducts. Electric foot-warmers are used under the bowl stands to raise the dough for breadmaking. Besides the 500 standard loaves baked each week and given to charity a quantity of rolls are handed out to persons passing the booth. The cost of operating this electric-baking exhibit, including space rental, labor, etc., is shared equally by the three companies named.

Among out-of-town electrical visitors to the Chicago Electrical Show last week were Mr. H. B. Woodill, of the Woodill & Hulse Electric Company, Los Angeles, Cal., a prominent contractor and supply dealer of the Pacific Coast; Mr. G. M. Sanborn, of the Sanborn Electric Company, Indianapolis, former president of the National Electric Contractors' Association; Mr. O. M. Rau, electrical engineer of the Milwaukee Electric Railway & Light Company; Mr. H. E. Rice, manager of the Philadelphia Electrical Exhibition; Mr. Frank B. Rae, of *Selling Electricity*, New York; Mr. J. F. Roche, secretary and treasurer of the Billings (Mont.) Water-Power Company; Mr. L. M. Brown, of the Memphis Electric Company, Memphis, Tenn.; Mr. Robert S. Hale, superintendent of the sales department of the Edison Electric Illuminating Company of Boston, and Mr. W. B. Donkin, contract agent of the Allegheny County Light Company, Pittsburgh, Pa.

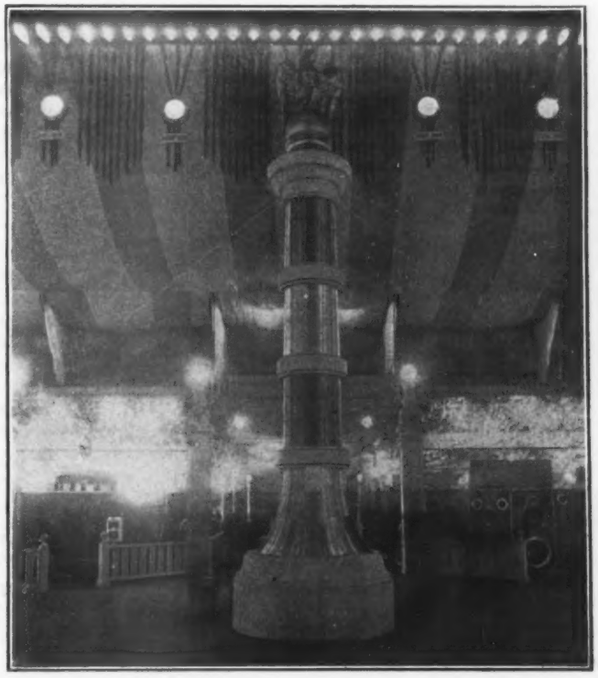


Fig. 3—Column of Copper and Iron-Wire Reels, Estimating Contest, Chicago Electrical Show, 1911.

Industrial and Commercial News

The Week in Trade.

BETTER conditions in commercial trade were quite apparent during the past week. The post-holiday quiet has almost disappeared, and retailers are enjoying a fair measure of success in their clearance bargain sales. Wholesalers and jobbers are also reporting a better outlook for spring business. The salesmen sent out shortly after the first of the year are beginning to send in orders, and while these as a rule are smaller than usual, their variety and number seem to indicate that many stocks are depleted. The buying of the country merchants is still marked by the conservatism that has been apparent for the last eight months. In the industrial world there is little change. The textile manufacturers are apparently unwilling to expand, owing to the uncertain conditions of trade and high price of raw cotton. In the iron and steel trade there is a better feeling, but actual developments show little change. It has now practically been determined that there will be no price cutting, and many manufacturers believe that the positive settlement of this point will cause orders to come in which have heretofore been held up in hopes of better terms. It is expected that the railroads will figure in the demand, as it is well known that the majority of them are in need of equipment and rails. During the past week it is stated that orders for 220 locomotives were placed, and the Pennsylvania Railroad made contracts for 1000 steel cars to fill in missing numbers. The same railroad company's order for 150,000 tons of rails has finally been accepted by the mills. The New York Central Railroad's specifications have not yet been accepted, but it is believed that they will soon be adjusted on a satisfactory basis. There were also placed during the week orders for 20,000 tons of rails from various roads, and it is stated that contracts for 53,000 tons are pending. In the structural material line prospects seem to be fairly good, and a big tonnage is expected from the Eastern territory, especially from the neighborhood of Philadelphia. Collections are irregular, but are not so unsatisfactory as to cause any general complaint. From parts of the Northeast and East payments are slow, and from the South and Southwest they are generally very good. Business failures for the week which ended Jan. 12, as reported by *Bradstreet's*, were 353 as against 282 for the previous week, 291 for the same week in 1910, 319 in 1909, 431 in 1908 and 234 in 1907.

The Copper Market.

COPPER experienced another very depressing week, and all efforts to advance prices were futile. Many trade circulars were distributed during the period to show how much the apparent consumption of copper exceeded the production in 1910, but in spite of these circulars prices steadily declined, both here and abroad. While the figures that are being used to bolster up the market are correct, they do not mean in any way that the actual consumption of copper is equal to the production. The shifting of accounts may deceive the casual observer, but does not deceive the student of the copper market. The actual melting of copper is the consumption, and not the alleged deliveries either for domestic purposes or to the foreign account. It is intimated that domestic consumers are now storing copper in their yards, with the agreement that the metal is not to be paid for until required for actual use. Whether the price for such copper is fixed at the time of delivery or at the time of consumption does not appear. According to the latest statistics published, the world's production of copper in 1910 was about 865,000 tons. The distribution of exports for 1910 showed a large increase in shipments to the Continent as compared with England. Germany was the heaviest taker of copper, where 22,000 tons alone went into warehouse to facilitate trading in copper certificates on the German Exchange. The total shipments of American copper to Germany were 80,843 tons, as compared with 64,403 tons in the previous year. There was an increase in the exports to France, and also to Holland and Italy, but there was a decrease in the exports to England of about 27,000 tons. Prices on the Metal Exchange during the past week have been weak and, while there has been no change in the quoted figures, it is pretty generally understood that what few sales have been made have been at concessions. Exports for January, up to and including Jan. 16, were 16,444 tons. The daily call on the Metal Exchange Jan. 16 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.10	....
January	12.00	12.10	12.05
February	12.00	12.10	12.05
March	12.00	12.10	12.05
April	12.00	12.10	12.05

The London market, Jan. 16 was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	55 8 9	55 8 9
Standard copper, futures	56 5 0	56 6 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.15c	12.05c
London, spot	£56 15 0	£55 7 6
London, futures	57 12 6	56 2 6
Best selected	60 5 0	59 10 0

Industrial and Commercial Notes.

Georgia Power Company.—Plans for the hydroelectric development in northern Georgia which are being made by the Georgia Power Company are now in definite shape. This company, as was stated in our issues of Nov. 17 and 24, 1910, was formed by the consolidation of the Northern Georgia Electric Company, the Etowah Power Company and some smaller concerns. It has been authorized by the Railroad Commission of Georgia to issue $20,000,000 in stocks and bonds for the purpose of carrying out this work. The construction work will be done by the Northern Construction Company, of Michigan, of which C. Elmer Smith, of York, Pa., is president; A. W. McLimont, vice-president; C. O. Lentz, 71 Broadway, New York, chief engineer, and A. L. Kenyon, construction engineer. Almost all of the available water-power sites in northern Georgia have been acquired by Detroit interests, and these interests are the organizers of the Georgia Power Company. The company has at the present time four available sites: At Etowah, on the Etowah River; at Tallulah Falls, on the Tallulah River; at Neunan and at Buford, on the Chattahoochee River. When all of these sites are developed it is estimated that 155,000 hp will be generated. The first development that will be undertaken, and, in fact, construction work has already been commenced upon it, is at Tallulah Falls. At this point a dam 384 ft. long and 112 ft. high will be constructed. It is expected at this point to develop about 60,000 hp. The present plans for the generating station contemplate six 8000-kw turbines. A 100,000-volt transmission line of heavy copper wire will be constructed to Atlanta, ninety miles distant, where a substation will also be built. Secondary power will be distributed around the outskirts of Atlanta at 2300 volts. There are many large factories and cotton mills which are practically under contract, and the promoters of this enterprise are confident that they will have a market for all of the energy they can generate. The plant at Tallulah Falls is expected to be in operation within eighteen months.

Electrical Interests in Chicago Association of Commerce.—The comprehensive ways and means committee of the influential Chicago Association of Commerce has been selected for the year 1911. The sub-committee representing electrical goods, electric lighting, gas fixtures and wire is made up as follows: Thomas I. Stacey, Electric Appliance Company, chairman; F. A. Ketcham, Western Electric Company; G. M. Beardslee, Beardslee Chandelier Manufacturing Company; James M. Gilchrist, Federal Electric Company, and Charles H. Roth, Roth Brothers & Company.

New Plant at Minneapolis.—R. A. Phillips and Walter Goodenough, engineers, representing Stone & Webster, of Boston, have announced from Minneapolis that a new central station of steel and concrete will be erected at once for the Minneapolis General Electric Company. The cost of this will be about $750,000. C. Y. Ferris, personal representative of Stone & Webster, is in Minneapolis to direct the construction of this new plant.

Lehigh Valley Extending Telephone System.—The success of the telephone train-dispatching circuits recently installed on the Lehigh Valley Railroad has led to extensions of this new method of handling train movements. A telephone line has just been cut into service between Packerton and Bernice, Pa., the dispatcher being located at Wilkes-Barre. The telegraph will soon be supplanted also between Wilkes-Barre and Sayre, adding about ninety miles more. The new circuit just placed in operation is known as the eastern end of the Wyoming division. It connects with about twenty-five way stations and is approximately 140 miles long. This train wire is divided into three sections, each radiating from Wilkes-Barre. The signaling equipment is so arranged that when a dispatcher calls any station signaling impulses are sent out over that particular section only. One section, which is known as the Mountain Cut-Off, has a special arrangement whereby in the event of any trouble on the train wire it is possible to connect it into the main line, thus fitting the circuit on either side of the trouble and enabling the dispatcher still to get every station. The complete equipment of telephone and selector apparatus has been furnished by the Western Electric Company. The Lehigh Valley plans eventually to use the telephone exclusively for the important work of dispatching trains.

Garwood Electric Company.—The power station which the Garwood Electric Company has furnished for the new Whitehall Building at 17 Battery Place, New York, is now all installed, a portion of it is in operation and the balance will be in operation as soon as the steam engines are ready for service. This installation, which is one of the largest isolated plants which have recently been built in New York, consists of three 300-kw, 225-volt, 100 r.p.m. generators and one 150-kw, 225-volt, 110 r.p.m. generator, direct-connected to Corliss engines built by the Providence Engineering Company. There are also one 5-kw and two 15-kw balancer sets, to be used in connection with the three-wire system. These generators are of the Garwood Electric Company's new type. The new Whitehall Building, it is said, will be the largest office building in the world. It will operate thirty-four elevators and approximately 5000 electric lights of 16-cp efficiency. The installation for which the Garwood company has furnished the generators will provide all of the energy used by the building, including motor, lighting and ventilator service. A few tenants have already entered the building, but it will not be entirely ready for service before March 1.

Chicago Advertising Association.—"Round Tablers" is the name of a newly organized group of advertising men who meet every Friday noon in the rooms of the Chicago Advertising Association for the purpose of promoting a systematic study of trade publicity. Addresses are delivered by invited speakers, after which a wide-open discussion follows. During the month of December the following subjects were taken up: "Large Space in Advertising," R. R. Shuman; "Style in Advertising," A. B. Jensen; "Cultivating the Dealer," S. DeWitt Clough; "Planning a Campaign," Frederick A. Farrar. Stenographic reports of the meetings are taken and a transcript is furnished each member of the organization. The officers for the ensuing three months are: Chairman, A. N. Fox; vice-chairman, Frederick A. Farrar; secretary, G. G. Place.

Rockingham Power Company.—It is probable that construction work will be commenced upon the plant of the Rockingham Power Company, at Blewitts Falls, on the Yadkin River, N. C., some time in February. This property was bid in by the reorganization committee at the foreclosure sale Nov. 24, 1910. It is now held in the name of E. Clifford Potter, treasurer of the Colonial Securities Company, of Boston. The new owners are formulating a financial plan for the organization of a new company, and are also having expert examinations made of the property by engineers before entirely determining upon the amount of work that will be done. A considerable amount of construction work has already been put into this plant, but it is not yet entirely determined as to what will be necessary to complete it. Under the original plans it was expected to develop about 30,000 hp.

Western Power & Irrigation Company.—The Western Power & Irrigation Company, of Oklahoma City, which was recently organized with a capital of $500,000, proposes to begin work at once upon a hydroelectric plant on the Washita River. At this development a concrete dam will be built, and it is expected that 650 hp will be generated. The energy will be transmitted to Mountain View, Okla., for the municipal plant and also supplied to farmers along the way for irrigation purposes. William L. Church, president of the Ambursen Hydraulic Construction Company, of Boston, has been retained as consulting engineer. The company also owns several other valuable water sites.

Chicago Telephone Company.—In its contest against the proposed reduction in rates for telephone service the Chicago Telephone Company has engaged former Assistant Corporation Counsel Hoyne. Mr. Hoyne appeared for the City of Chicago in framing the present telephone ordinance. General Engineer Wray, of the Chicago Telephone Company, has informed the Council committee that its experts' report is mixed up on valuations and errs in basing the cost of construction on the last ten years' work. The increase in labor, material, etc., has recently been so great that it is claimed that the cost of construction work is considerably underestimated.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Cedar Rapids, Ia.; Lexington, Ky.; Koppel, Pa.; Mountain View, Okla.; Portland, Ore.; Minneapolis, Minn.; Chicago, Ill.; Mountain Home, Idaho; Etna, Pa.; Greensboro, N. C.; Hamburg, Ark.; Crystal City, Tex.; Austin, Tex.; Ukiah, Cal.; El Centro, Cal.; Medford, Ore.; Knightsville, Ind.; Marble Falls, Tex.; Saybrook, Ill.; Atlantic, Ia.; Douglas, Ariz., and Clifton, Ariz.

Foreign Trade Publicity.—The Bureau of Manufactures of the Department of Commerce and Labor at Washington is establishing a file of the names of American manufacturers and traders, for use in distributing the valuable information which reaches it from time to time in regard to foreign trade. Those who desire to avail themselves of the facilities thus offered for extending their trade abroad should send to the bureau their names and advise it as to the class of business in which they are engaged.

Aluminum Company of America.—The Aluminum Company of America (controlled by the Mellon family, of Pittsburgh) has purchased 3500 acres of land, including Bernhart's Island, in the St. Lawrence River below Prescott, Ont., and proposes installing a plant capable of developing 300,000 hp. In the event of permission being given by the Canadian government, the company is reported to be prepared to expend $40,000,000 on the power development.

Financial.

THE WEEK IN WALL STREET.

THERE was an improvement in the stock market in price during the past week, and there was some little increase in the amount of trading. This betterment was not particularly encouraging, however, as there was very little evidence that any others than professionals were taking part in the market, and outside orders seemed to be entirely lacking. The many narrow swings that characterized the market but emphasized the fact heretofore referred to that there is very

NEW YORK.

	Jan. 9.	Jan. 16.	Shares Sold.		Jan. 9.	Jan. 16.	Shares Sold.
All. Ch.....	8¼*	8	200	Int. Met., pfd	54½	53⅞	3,500
All. Ch., pfd.	28½*	28*	300	Mackay Cos.	92⅞*	92⅞*	——
Amal. Cop...	64¼	63½	55,510	Mackay C.,pf.	75¾	75⅞	500
Am. D. T...	20½*	20½*	——	Man. Elev...140		140*	325
Am. Loco...	40	40	3,725	Met. St. Ry..	15*	15*	——
Am. Loco.,pf.108½*		110	200	N.Y.&N.J.Tel.139¼*		139¼*	——
Am. Tel. & C.	83¾*	85	100	Steel, com..	74⅞	76	524,475
Am. T. & T..141½		142¼	13,948	Steel, pfd....	118⅜	118¾*	7,385
B. R. T....	76⅛	77⅛	26,310	W. U. T....	74¼	74¼	4,000
Gen. Elec...151½		151*	3,550	West'h, com.	66½*	67*	1,350
Int. Met....	19¾	19⅛	4,525	West'h, pfd..123*		116*	120

PHILADELPHIA.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16.
Am. Rys.....	42	43½	Phila. Elec.....	16½	16¾
Elec. Co. of A.....	11⅞	12½*	Phila. R. T.....	19¾	19¾
Elec. St. B'ty.....	50¼	50½	Phila. Trac.....	84½	85
E. S. B'ty., pfd.....	30*	30*	Union Trac.....	45¼	76¼

CHICAGO.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16.
Chi. City Ry.....170*		185*	Chi. Tel. Co.....	120	120*
Chi. Rs., Ser. 1....	92½*	92½*	Met. El. Co.....	22*	22*
Chi. Rs., Ser. 2....	25	23½*	Met. El., pfd.....	69*	68
Com. Edison.....115		113½*	Nat'l Car.....	119*	117*
Chi. Subways.....	4½	4¼*	Nat'l Car., pfd.....	117½*	117½*

BOSTON.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16.
Am. T. & T.....141⅞		142¼	Mex. Tel.....	6	6*
Cum. Tel.....149¾		147*	Mex. Tel., pfd.....	6*	6*
Edison E., Ill.....290		290	N. E. Tel.....138		137½
Gen. Elec.....152¼		151	W. T. & T.....	18*	17*
Mass. E. Ry.....	18*	18*	W. T. & T., pfd....	91½	91½*
Mass. E. Ry., pfd...	84¼	84½			

*Last price quoted.
Shares sold for five days, Jan. 9 to Jan. 14.

little stock for sale. It might not be entirely incorrect to say that the market is oversold, although if such an expression should create the impression that there is any considerable short interest in the market it would be erroneous. There is no doubt some short interest in stocks, much of which has been sold at lower prices than are at present quoted. In order to realize upon such deals, it seems to be the policy of a great number of professional traders to put an extreme bearish construction upon every piece of news that comes into the financial world. The fact that the City of New York has been compelled to fix its rate of interest at 4½ per cent on its new loan and the fact that the directors of the Pennsylvania Railroad were contemplating an issue of $100,000,000 of additional stock were emphasized and enlarged during the past week for depressing effects. Prices, however, did not recede and at the close of the week were several points higher on most of the active issues than at the opening. The market is in this interesting condition that if any outside activity can be stimulated there will be an upward movement. It is not likely that there will be any sharp decline, for the reason stated above, that the long accounts now being carried are extremely light. The banking condition is entirely satisfactory. This is more thoroughly emphasized by the fact that with the closing of several important institutions, and the necessity for helping several others, there was no flurry in the money market. It is now a common expression in Wall Street that the depositors of no regularly organized New York bank will ever be allowed to lose money as long as present banking interests dominate and are able to furnish protection. Quotations for money Jan. 16 were: Call, 2¾ @ 3 per cent; 90 days, 3½ @ 3¾ per cent. The quotations in the table are those of the close Jan. 16.

Financial Notes.

Electric Combine Near Pittsburgh.—Negotiations are now being carried on with a view to the consolidation of a dozen or fifteen electric companies in the Beaver and Upper Ohio River Valleys, near Pittsburgh. It is stated that the interests at work upon this combination have already secured the Beaver County Light Company, New Brighton, Pa. This concern is building a dam at Beaver Dam which will generate a large amount of energy. The combination, it is stated, was formed by W. Caryl Ely and Van Horn Ely, of Buffalo, who have partly financed the deal with the Girard Trust Company, of Philadelphia; E. T. Stotesbury, of Drexel & Company, and J. G. White & Company. The statement that these parties were acquiring the properties in the interests of the General Electric Company was semi-officially denied at the offices of the latter company. It was officially stated that negotiations were pending, but that it would probably be two weeks before any definite announcement could be made.

Kentucky Electric Company.—The stockholders of the Kentucky Electric Company, of Louisville, have voted to reincorporate under the laws of Delaware and to increase the capital stock from $600,000 to $3,000,000. The company has also completed plans for the construction of a large power house on the Ohio River water front between Second and Third Streets. Several months ago a movement was on foot for the consolidation of this company with the Louisville Lighting Company, having a capital of $3,000,000, and the George G. Fetter Lighting & Heating Company, with a capital of $200,000. After long negotiations with the city authorities this plan was abandoned because no new franchise could be secured which was satisfactory to the stockholders of the three companies. The present franchise of the Louisville Lighting Company is perpetual and practically all of the stock of that company belongs to the Louisville Gas Company.

Hudson River Power Company.—The Boston bondholders' committee of the Hudson River Power Company has now on deposit $8,374,000 of bonds. The committee, together with several New York Trust Companies, is objecting to the allowances sought by the receivers and to the counsel fees. This matter will probably have to be adjudicated in court. The Windsor Trust Company, of New York, has sent out a circular letter to the bond depositors, stating that over 75 per cent of the bonds have been deposited and will be turned over to the Boston committee. After these bonds are turned over the other bondholders' committees will go out of business.

Chattanooga Railway & Light Company.—The gross and net earnings of the Chattanooga Railway & Light Company for 1910 were substantially higher than those for the previous year. The last official report which has been made public was for the twelve months ended Sept. 30, which showed that the gross earnings were $850,619, as compared with $763,478 for the previous year, and the net earnings for the same period increased $77,585. The surplus at the end of that twelve months amounted to $125,516. This company owns and operates the entire street railway and electric lighting business of Chattanooga and vicinity, and serves a population of about 75,000. Recently extensive building operations have been carried on by the company, and transmission lines are being extended to outlying districts.

Rockford Electric Company.—First and refunding-mortgage 5 per cent gold bonds of the Rockford (Ill.) Electric Company to the amount of $550,00 are advertised for sale in the daily newspapers. The advertisement states that the Rockford company controls the entire commercial electric light, electric power and steam-heating business in the City of Rockford under long-time franchises. The city has a population of about 45,000 and is well known for its diversified manufacturing interests. The amount of these bonds outstanding is $1,232,000, and they are a first mortgage on the entire property of the company, subject only to $28,000 in Rockford Edison 5's on the electric properties. The bonds are offered for sale at 96½.

Stone & Webster Engineering Corporation.—A report has been filed with the Secretary of the State of Massachusetts by the Stone & Webster Engineering Corporation, of Boston, showing its financial condition on Nov. 30, 1910. This report shows real estate, $480,402, and other assets sufficient to bring up the total to $1,231,553. The company has $500,000 of liabilities and its balance sheet shows profit and loss of $82,640. During the year the Stone & Webster properties have shown remarkable improvement in earnings. Without exception, all of the properties operated by this firm ended the year 1910 with records of largely advanced earnings and very much better physical condition.

American Telephone Bonds.—There has been considerable activity in the collateral trust bonds of the American Telephone & Telegraph Company in the Boston market during the past few weeks. It is said that between $2,500,000 and $3,000,000 of these bonds have changed hands since the first of the year in that market. It is understood that the Massachusetts savings banks have been the principal buyers. There is some mystery as to where this amount of bonds came from, but the general impression is that the greater part were sent from Europe for sale in Boston. The important feature in these transactions is the fact that savings banks are buying these bonds at a figure which nets an interest of about 4¾ per cent.

Winnipeg Electric Railway Company.—It has been announced that the Winnipeg Electric Railway Company will begin work at once upon a subsidiary steam power house in Winnipeg which will cost $500,000. Recently a decision prohibited the company from furnishing power to the City of Winnipeg from its hydroelectric station at Lac du Bonnet, and an appeal against this decision has been taken to the Privy Council. The determination to construct the steam power station was made in order to put the company in a position to continue active operations no matter what the decision as to the hydroelectric station may be.

Wisconsin Telephone Company.—The Wiscosin Telephone Company for the year 1910 shows a gain of 4400 subscribers, the largest increase in the company's business since its organization. Approximately 1000 of these subscribers were obtained within the last two months of the year, when a campaign for new business was actively inaugurated. The company expects to continue this sort of missionary work throughout 1911.

Suburban Electric Light Company, of California.—The Pacific Gas & Electric Company, of California, has succeeded in acquiring control of the Suburban Electric Light Company, of San Leandro, Cal. This company has supplied energy to quite a number of small towns in its locality. It has outstanding $503,350 capital stock and $250,000 bonds.

Westinghouse Machine Company.—It has been announced that practically all of the holders of the extension notes of the Westinghouse Machine Company have already assented to the plan recently indorsed by the creditors' committee for refinancing. This plan was described in our issue of Dec. 8, 1910.

Electric Boat Company.—The regular dividends of the Electric Boat Company were not declared for the last quarter of 1910. This is the second consecutive quarter at which the preferred dividend has been passed. The regular annual distribution on the common stock from Jan. 1, 1907, to Jan. 1, 1909, was 2 per cent. The quarterly 2 per cent dividend on the preferred stock has been paid from 1903 up to July 1, 1910. The officials of the company say that the conditions of the company's affairs have not materially changed since October, when President Isaac L. Rice said: "The company has a large amount of business on hand and the outlook is excellent; and this has required the use at present of all the capital and earnings. It was the consensus of opinion among the directors that under the circumstances it would be wise to suspend dividends for the present." The failure to declare the quarterly preferred dividend and annual common dividend has provided the company with approximately $205,000 working capital.

Consolidated Gas Company.—It seems to be practically settled, at least it is the unanimous opinion in financial districts, that the Consolidated Gas Company will purchase the Brooklyn Union Gas Company. In 1910 the Consolidated earned about 8 per cent on $100,000,000 capital stock and the Brooklyn Union 11.2 per cent on $18,000,000 capital stock. Both companies own wholly or in part various other companies. The Consolidated owns or controls practically all of the gas and electric light companies in Manhattan and the Bronx, together with the Astoria Light, Heat & Power Company. The Brooklyn Union owns only gas companies, but owns them outright. During the past year the Consolidated has acquired the last few shares of the New York Edison Company's stock. The surplus earnings in 1910 applicable to dividends amount to about $8,100,000 for the Consolidated and $2,100,000 for the Brooklyn Union.

Receivers for Telephone Companies.—Charles E. Wilson, general manager of the Keystone Telephone Company, of Philadelphia, has been appointed receiver for the Continental Telephone & Telegraph Company, against which bankruptcy proceedings were brought last summer. This company was incorporated in New Jersey in 1909 with a nominal capital of $50,000,000, and shortly after its incorporation authorized a bond issue of $25,000,000. The company in acquiring independent telephone properties incurred obligations amounting to more than $2,000,000. In Pittsburgh William Flynn and Joshua G. Splane have been appointed receivers for the Pittsburgh & Allegheny Telephone Company, which was one of the largest independent concerns in that section. The company has issued $2,000,000 of preferred and a like amount of common stock, together with bonds amounting to $1,400,000.

Mahoning & Shenango Railway & Light Company.—The earnings of the Mahoning & Shenango Railway & Light Company, of New Castle, Pa., and Youngstown, Ohio, showed a large gain in 1910 over those of the previous year. Definite figures for the calendar year are not as yet obtainable, but the increase in surplus for the twelve months which ended Sept. 30 was $117,604. The Mahoning & Shenango Railway & Light Company's system compries 145 miles of electric railway in the valleys of the Mahoning and Shenango Rivers and also includes the electric lighting systems of Youngstown, New Castle and Sharon, as well as various smaller places. The population of the territory served is rapidly increasing and there is a great amount of natural resources as yet undeveloped. The franchises of the company are either perpetual or will extend well beyond maturity of all the bonds, which is Jan. 1, 1916. The limited franchises of the company have recently been renewed for twenty-five years.

Pacific Telephone & Telegraph Company.—Bond & Goodwin, of Boston, have bought $5,000,000 of two-year 5 per cent coupon notes of the Pacific Telephone & Telegraph Company. This company is one of the largest subsidiaries of the American Telephone & Telegraph Company and operates over a large territory on the Pacific Coast. It is said that the Boston firm has resold this issue at private sale, largely to interests in New York, New England and the West. The notes were issued to provide for new construction.

Boston & Worcester Electric Company.—It is reported that James H. Parks, representing a syndicate of American and foreign investors, has secured an option sufficient to control the Boston & Worcester Electric Company. This option, it is understood, is to run a sufficient period to permit an expert engineer to make a definite appraisal of the value of the property.

DIVIDENDS.

Brooklyn City Railroad Company, quarterly, 2 per cent, payable Jan. 16.

Commonwealth Gas &. Electric Companies, quarterly, 1¼ per cent, payable Jan. 16.

Connecticut Railway & Lighting Company. quarterly, preferred, 1½ per cent, common, 1½ per cent, both payable Feb. 11.

Consolidated Traction Company of New Jersey, semi-annual, 2 per cent, payable Jan. 15.

Electric Bond & Share Company, preferred, quarterly, 1¼ per cent, payable Feb. 1, common, quarterly, 2 per cent, payable Jan. 16.

Electric Company of America, semi-annual, 3½ per cent, payable Feb. 3.

Guanajuato Power & Electric Company, preferred, 1½ per cent, payable Feb. 1.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent, common, 1½ per cent, both payable Feb. 11.

Mexican Lighting & Power Company, Ltd., 1 per cent, payable Jan. 20.

Mexican Tramways Company, quarterly, 1¾ per cent, payable Feb. 1.

Pacific Coast Power Company, semi-annual, 2 per cent on common, ½ per cent extra, 3 per cent preferred, all payable Jan. 16.

Public Service Investment Company, Boston, preferred, quarterly, 1½ per cent, common, semi-annual, 1½ per cent, both payable Feb. 1.

Railways Company General, quarterly, 1 per cent, payable Feb. 1.

Rio de Janeiro Tramways, Light & Power Company quarterly, 1¼ per cent, payable Feb. 1.

United Traction Company, of Pittsburgh, semi-annual, preferred, 2½ per cent, payable Jan. 20.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus
Associated Bell Companies—					
11 months ended Nov. 30, 1910	$150,244,013	$104,247,779	$45,996,234	$10,513,012	$35,483,922
11 months ended Nov. 30, 1909	135,151,170	91,229,184	43,921,986	9,670,296	34,251,690
Cape Breton Electric Company, Ltd.—					
November, 1910	29,403	14,639	14,764	6,066	8,698
November, 1909	26,535	13,776	12,759	6,175	6,584
Edison Electric Illuminating Company of Boston—					
December, 1910	542,463	204,928	337,535	.....	.....
December, 1909	505,249	202,436	302,813	.....	.....
Electric Light & Power Company, of Abington and Rockland—					
November, 1910	9,539	6,507	3,032	536	2,496
November, 1909	9,143	5,268	3,875	801	3,074
Houghton County Electric Light Company—					
November, 1910	29,018	12,768	16,250	4,554	11,696
November, 1909	28,082	11,622	16,460	4,266	12,194
Keystone Telephone Company—					
December, 1910	96,851	47,439	49,412	24,519	24,893
December, 1909	94,790	47,406	47,834	25,169	25,169
Kings County Electric Light & Power Company—					
December, 1910	427,679	183,613	244,066	.....	120,678
December, 1909	366,428	175,488	190,940	.....	88,041
Long Island Railroad Company—					
November, 1910	750,352	634,993	137,023	43,570	93,452
November, 1909	701,464	527,051	226,091	43,570	182,520
Paducah (Ky.) Traction & Light Company—					
November, 1910	21,523	11,650	9,873	7,840	2,033
November, 1909	20,710	11,319	9,391	6,621	2,770
United Railways of St. Louis—					
November, 1910	952,871	628,117	328,310	232,151	96,159
November, 1909	923,427	581,014	346,436	232,107	114,329

General News

Construction News.

CLIFTON, ARIZ.—Plans are being considered by the Twin Peaks Mining Company for the construction of a power plant at York Station, from which electricity will be transmitted to its works to operate the machinery in its mines and reduction plant.

DOUGLAS, ARIZ.—It is reported that preparations are being made by the Copper Queen Mining Company, of Douglas, for the installation of two turbo-generators to supply electricity for operating machinery in its mines.

PRESCOTT, ARIZ.—The Climax Mining Company is reported to be contemplating extensive improvements to its property, including the erection of a hydroelectric power plant and a large ore-reduction plant, at Prescott, Ariz., where a ten-stamp crushing mill was recently erected.

EUREKA SPRINGS, ARK.—Owing to its plant being operated at a loss, the Eureka Springs Electric Company announce that the day service will be discontinued after Feb. 1, 1911.

FORDYCE, ARK.—The plant and holdings of the Fordyce Light & Water Company have been purchased by J. S. Morgan, owner of the Eldorado water and light plants, of Eldorado, Ark.

HAMBURG, ARK.—It is reported that arrangements are being made by the Missouri & Arkansas Lumber Company for rebuilding its plant, which was destroyed by fire some time ago. The company will be in the market for power and operating machinery.

ALAMEDA, CAL.—The City Council is considering the question of building a new power station and will probably call an election to vote on the proposition to issue bonds for same. The cost of the building is estimated at $50,000.

BAKERSFIELD, CAL.—Preparations are being made by the San Joaquin Light & Power Company to suppply electricity to the Midway oil fields. A large part of the material for the construction work has been purchased.

EL CENTRO, CAL.—Plans are being prepared by W. F. Holt and associates for the construction of a large steam-driven electric generating plant to cost about $250,000. The proposed plant will supply electricity for the entire Imperial Valley.

EUREKA, CAL.—The plant and holdings of the Humboldt Gas & Electric Company, of Eureka, Cal., have been purchased by M. H. Byllesby & Co., of Chicago, Ill. The property will be turned over to and will be controlled by the Western States Gas & Electric Company, a company recently organized with a capital stock of $15,000,000, which operates a number of plants on the Pacific Coast.

JACKSON, CAL.—John L. Henry is reported to have been granted a fifty-year franchise by the Board of Supervisors to erect and operate an electric system. It is understood that Mr. Henry proposes to supply electricity in the town of Plymouth.

PLACERVILLE, CAL.—Notice of appropriation of 5000 in. of water in Silver Lake has been filed with the County Recorder by Thomas G. Patton. The water will be diverted by means of a dam, ditch and flume and will be utilized for domestic, mining, irrigation and for generating electricity.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has awarded the contract for the construction of an intake for its power plant at San Diego to Charles W. Carbaley, of Los Angeles, Cal. The work will consist of two 5-ft. conduits leading from the bay at the foot of E Street to the power house, which will be located at Arctic Street and E Street.

UKIAH, CAL.—Preparations are being made by the Snow Mountain Water & Power Company for extensive improvements and extensions to its system. W. S. Graham has been appointed general superintendent of the company, with headquarters at Ukiah.

VISALIA, CAL.—The Visalia Electric Railroad Company is contemplating an extension of its railway during this year which will connect Lemon Cove and Three Rivers. About eleven miles of track will be built.

WATSONVILLE, CAL.—It is reported that investigations are being made with a view of the rehabilitation of the Watsonville Electric Transportation Company, which formerly operated an electric railway between Watsonville and Port Watsonville, with a view of extending the railway farther back into the valley.

CARBONDALE, COL.—The Board of Trustees has granted the Aspen Light Company a franchise to supply electricity for lamps and motors in Carbondale for a period of twenty years. Under the terms of the franchise the company is to supply electricity at the rate of 20 cents per kw-hour, with a minimum charge of $2. A twenty-four-hour service will be established. The company, it is said, is to be capitalized at $25,000.

FOWLER, COL.—The City Council has granted the Pueblo & Suburban Traction & Lighting Company, of Pueblo, Col., a ten-year franchise to supply electricity for lamps and motors in Fowler. It is expected that transmission lines will be extended to Fowler at once.

MONTROSE, COL.—The Uncompahgre & Gunnison Valley Company is reported to have awarded the contract for the engineering work in connection with its proposed electric railway, twenty-nine miles in length, to connect Montrose and Delta, to M. L. Paret, of Kansas City, Mo. J. M. Pepper, of Montrose, Col., is interested in the project.

GEORGETOWN, CONN.—The installation of a distributing system for street-lighting service in Georgetown is nearly completed. Electricity for operating the system will be supplied by the Connecticut Company. Incandescent street lamps are to be used.

GREENWICH, CONN.—The Housatonic Electric Lighting Company is reported to have appropriated $100,000 for the construction of a gas-producing and distributing plant in Greenwich, Conn.

PUTNAM, CONN.—The Putnam Light & Power Company will petition the State Legislature for permission to extend its system in the Town of Woodstock for the purpose of supplying electricity for lamps and motors.

ROCKVILLE, CONN.—The Rockville-Willimantic Lighting Company has adopted a new schedule of rates for electricity for lamps, to take effect from Jan. 1, 1911. The rate in Rockville, Stafford and Willimantic will be 16 cents per kw-hour for the first 100 kw-hours and 13 cents per kw-hour for all over 100 kw-hours, with a discount of 1 cent per kw-hour for prompt payment. The minimum charge will be $1 per month, as at present.

WINDSOR LOCKS, CONN.—The stockholders of the Connecticut River Company have voted to accept the amendment to its charter obtained from the Legislature giving the company the right to construct additional dams and to erect and maintain a power station.

WASHINGTON, D. C.—A commission agent in an European country informs an American consul that he desires to correspond with manufacturers of electrical wire and of iron gas fittings and connections. For further information address Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C., referring to file No. 6104.

WASHINGTON, D. C.—A report from an American consul in Latin America gives particulars of the organization of a new company which proposes to construct a large hydroelectric plant and which will soon be in the market for machinery and equipment for same. For further information address the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C., referring to file No. 6106.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 31, for material to be delivered at navy yards as follows: Brooklyn, N. Y.—Schedule 3261, 195 non-watertight bells and buzzers, 400 dry cells, 150 electrose insulators, 15 electric soldering irons and 400 lb. rubber insulating tape; schedule 3268, one induction motor. Boston, Mass.—Schedule 3261, 22 soldering irons, 300 lb. rubber insulating tape and miscellaneous electrical supplies. Annapolis, Md.—Schedule 3259, three induction motors.

JACKSONVILLE, FLA.—Arrangements are being made by the Board of Trustees to take over the commercial lighting and power business of the Jacksonville Electric Company as provided in the recent franchise granted the company to use the streets of the city for a street car system. At a recent inventory the valuation of the transformers, poles, wires, etc., used for its commercial lighting and power service was estimated at $22,892.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company has placed orders with the General Electric Company for one 2750-kw turbo-generator with station equipment, one 500-kw motor generator set with step-down transformers, and one 300-kw motor generator set with step-down transformers.

EAST POINT, GA.—The Atlanta Utility Works, of East Point, Ga., is reported to be in the market for one 5-hp, three 10-hp and one 20-hp, 220-volt, 60-cycle induction motors. For further information address W. W. Rushton, secretary and treasurer.

LAGRANGE, GA.—The Gainesboro Telephone & Telegraph Company is reported to be contemplating increasing its capital stock by $280,000. J. C. Bass is president.

CLARKS FORK, IDAHO.—The MacGillis & Gibbs Lumber Company, of Milwaukee, Wis., and Spokane, Wash., has established an office in Clarks Fork, where, it is said, a large timber-cutting plant will be erected. The plant will be equipped for electrical operation.

MOUNTAIN HOME, IDAHO.—The Thousand Springs Power Company is reported to have decided to install a power plant and erect a transmission line five miles in length along the Snake River to a point below Brown's flats, where a pumping plant will be installed. The proposed plans call for an expenditure of about $300,000 and the irrigation of several thousand acres of land in Southern Idaho. Dr. R. G. Roberts, of Mountain Home, is the Idaho representative of the company.

BELVIDERE, ILL.—The Common Council has granted the Public Service Operating Company a new franchise in Belvidere. The company

has a ten-year contract for street lighting in this city. A. J. Stahl is president of the company.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway & Light Company has filed an amendment to its charter increasing its capital stock from $600,000 to $900,000.

CHAMPAIGN, ILL.—It is reported that the Illinois Traction System is negotiating for the purchase of the Wabash, Chester & Western Railroad, which extends from Mount Vernon to Chester, a distance of fifty miles. Surveys have been completed by the McKinley interests nearly the entire distance between Cairo and East St. Louis. The railway is in operation between Cairo and Mounds, and it is understood that the promoters intend to resume construction work as soon as the weather will permit.

CHICAGO, ILL.—It is reported that plans are being considered by the Corn Products Refining Company, 26 Broadway, New York, N. Y., for large extensions to its Argo works, in the suburbs of Chicago, Ill., during the coming year. The company will purchase a large amount of power equipment and special machinery.

COLLINSVILLE, ILL.—The Collinsville Electric Light Company is reported to have awarded the contract for the construction of its new power house to Thomas Sauer. It is expected that the City of Collinsville will install additional arc lamps to the street lighting system when improvements to the plant are completed.

DECATUR, ILL.—The Wabash Railroad Company is reported to have made arrangements to secure electricity for operating its shops in Decatur from the Decatur Railway & Light Company, a subsidiary of the Illinois Traction Company, the contract calling for 1400 hp. It is understood that the electrical equipment and engines now in use at the local shops will be transferred to the railroad company's plant at Moberly, Mo.

MOMENCE, ILL.—The W. B. Harpole & Son Electric Light Company has purchased a 200-kw, 2300-volt, three-phase, 60-cycle Westinghouse alternator, a 7½-kw exciter and complete switchboard equipment for recent extensions found necessary to its lighting system.

PORT BYRON, ILL.—Extensive improvements are contemplated by the Crescent Telephone Company to its Port Byron system, which will include the erection of new poles and wires and remodeling the exchange building.

SAYBROOK, ILL.—R. C. Cooper, owner of the electric-light plant, recently burned, is reported to be contemplating the installation of a new plant to supply electricity in Saybrook, Arrowsmith and Gibson City.

BLUFFTON, IND.—The City Council has placed contracts for additional equipment for the municipal electric-light plant, involving an expenditure of about $10,000. The equipment will consist of a 450-hp engine manufactured by the Harrisburg Foundry & Machine Company, of Harrisburg, Pa.; generator and other electrical equipment to be supplied by the Fort Wayne Electric Works, of Fort Wayne, Ind. The city will rent the equipment for two years, with option of purchase at the expiration of that period. At that time the city will make the last payment upon the municipal lighting plant.

EVANSVILLE, IND.—Preparations are being made by the Evansville Railways Company for an extension of its railway system from Mount Vernon to New Harmony, a distance of fifteen miles.

EVANSVILLE, IND.—J. A. Brown, who is building a new industrial town on the Kentucky side of the Ohio River, opposite Evansville, Ind., to be known as "Mortalies," it is reported, will build a railway to conmeet with Evansville, cars to be transported across the river by ferry. It is said that work will begin on construction of the proposed road in February.

GAS CITY, IND.—It is reported that the Gas City municipal water and electric light plant, recently destroyed by fire, will be rebult by the city. The loss is estimated at $40,000.

GREENSBURG, IND.—The Citizens' Telephone Company is asking for bids for the installation of an automatic switchboard.

KNIGHTSVILLE, IND.—Plans are being considered by the Town Board for the installation of an electric-light system; electricity for operating the system to be supplied by the Terre Haute, Indianapolis & Eastern Traction Company. The traction company is preparing a franchise, which will be submitted at the next meeting of the Town Board.

LEBANON, IND.—The capital stock of the Citizens' Electric Light Company has been increased by $50,000, the proceeds to be used for improvements and extensions to its system. Charles C. McReynolds is president of the company, and C. E. Layton is secretary.

RUSHVILLE, IND.—Extensive improvements are being made to the municipal electric-light plant and water-works system, which will involve an expenditure of about $13,000 and include the installation of three Heine safety water-tube boilers, with a rating of 210 hp each, equipped with chain stokers, and the erection of a brick chimney 125 ft. in height.

ATLANTIC, IA.—Plans are being prepared by the W. K. Palmer Company, engineers, 717-720 Dwight Building, Kansas City, Mo., for a new pumping and electric-light plant for Atlantic, for which bonds to the amount of $50,000 have been voted.

CEDAR RAPIDS, IA.—Plans are being prepared by the Cedar Rapids & Iowa City Railway & Light Company for the construction of two new power houses during the coming year. One will be located at Iowa City and the other at North Liberty.

CHARLES CITY, IA.—The Charles City & Western Railway Company is reported to be contemplating building about twenty miles of new track during 1911. C. W. Hart is president.

RED OAK, IA.—The Iowa Telephone Company has purchased the telephone system of the Montgomery County Telephone Company at Red Oak. Steps have been taken to consolidate the two companies.

ROCK VALLEY, IA.—At an election held Jan. 9 the citizens voted to grant an electric-light franchise to Star Thayer, engineer.

MANHATTAN, KAN.—Plans are being made by the Manhattan City & Interurban Railway Company for an extension of its railway from Manhattan to Fort Riley, fifteen miles in length, during the coming year. Joseph T. West, of Manhattan, is purchasing agent.

LEXINGTON, KY.—The Lexington & Interurban Railways Company has decided to build its power house in Lexington, Ky., instead of at Valley View on the Kentucky River.

LOUISVILLE, KY.—Plans have been approved by the stockholders of the Kentucky Electric Company, of Louisville, Ky., for extensive improvements and extensions to the plant and properties of the company during the year 1911 which will involve an expenditure of about $1,000,000. It is proposed to reincorporate the company and increase the capital stock from $600,000 to $3,000,000. The work includes the construction of a new generating station on Water Street between Second Street and Third Avenue. Upon completion of the new plant the present power house will be used as an auxiliary station. The company also proposes to supply steam heat in connection with the new plant. R. E. Hughes is president of the company.

OPELOUSAS, LA.—Plans are being considered for improvements and extensions to the municipal electric light plant, including the installation of additional machinery. Armas Durio is superintendent.

AUGUSTA, MAINE.—Announcement has been made by the Kennebec Light & Heat Company of a reduction in the rates of electricity, to take effect from Jan. 1, 1911. Under the new schedule the price will be reduced to 9 cents per kw-hour, with discounts of 5 per cent, 10 per cent and 15 per cent for prompt payment. The company in the last three and one-half years has voluntarily reduced its lighting rate from 43 per cent to 49 per cent, and has at the same time made many improvements to its service.

NEW BRUNSWICK, MAINE.—The Maine & New Brunswick Electrical Power Company has placed a contract with the S. Morgan Smith Company, through its Boston (Mass.) office, for a water-wheel unit to be installed at its Aroostook Falls plant. This unit will develop 2400 hp under a 72-ft. head. A. R. Gould, of Presque Isle, Maine, is managing director.

PITTSFIELD, MAINE.—The residents of Barnstead Parade are considering the question of lighting the town with electricity. A committee has been appointed to see if the Pittsfield Electric Light & Power Company would extend its transmission lines to that village and supply electricity there. C. F. Gardiner is manager of the Pittsfield Light & Power Company.

CUMBERLAND, MD.,—It is reported that surveys are being made for the proposed electric railway between Meyersdale, Pa., and Frostburg, Md., connecting with the Cumberland & Westernport Electric Railway in Cumberland and the Pennsylvania & Maryland lines operating through the Meyersdale field. The railway will eventualy connect Johnstown, Pa., and Cumberland, Md.

OWINGS MILLS, MD.—Bids will be received by Frank W. Keating, superintendent Maryland Asylum and Training School for Feeble-Minded, until Feb. 1, 1911, for plumbing, electric equipment, heating and power equipment in connection with buildings to be erected and alterations in connection with present buildings, inclusive of increase of present power plant, installation of additional boilers, etc., and construction of sewage disposal system, in accordance with plans and specifications prepared by Ellicott & Emmart, architects, and by Charles L. Reeder, consulting engineer, copies of which may be secured at the office of the engineer. 919 Equitable Building, Baltimore, Md.

BOSTON, MASS.—Announcement has been made by Superintendent of Streets Rourke that he has rejected all bids recently submitted to him for street lighting and would call for new bids. Bids were called for a smaller type of lamps, and the Rising Sun Street Lighting Company and the Boston Consolidated Gas Company, which hold the present contract, refused to bid. The Edison Electric Company, Ramsdell & Company and William A. Rumpf submitted bids.

CHICOPEE, MASS.—In the annual report of the municipal electric light plant submitted by J. H. Forsythe, superintendent, the installation of new boilers to be equipped with smoke-consuming devices was recommended.

FORGE VILLAGE, MASS.—The Lowell & Fitchburg Street Railway Company, which formerly secured electricity for operating its cars from the Boston & Northern Street Railway Company, is now taking the service from the Lowell Electric Light Corporation, which has necessitated the installation of two new transformers in the substation located in Forge Village owned by the Lowell & Fitchburg Street Railway Company.

HOLYOKE, MASS.—The annual report of the Gas and Electric Department, submitted by W. H. Snow, manager, shows an increase in the output of both the gas and electric plants. The gain in the gas plant was 5.22 per cent and in the electrical plant 28.7 per cent. Additions to the electric plant in the past year consisted of the installation of four 400-hp boilers, a 2500-kw turbo-generator set, with necessary pumps, con-

densers, etc., increasing the output of the station to about 8000 hp. The business of the plant will warrant reducing the price of street arc lamps from $60 each per year to $45, beginning with the new fiscal year, and a reduction in the price of the street incandescent lamps proportionately.

MONTAGUE, MASS.—The Montague Electric Light & Power Company has recently purchased a large gasoline engine to operate its plant during the low-water periods.

DETROIT, MICH.—It is reported that Benjamin Douglas, Ford Building, Detroit, Mich., would like to receive estimates on a gravel plant, to be located near Detroit, with an output of 600 cu. yd. per ten-hour day. Estimates are also wanted on a steam or an electrical power plant to operate the same.

DETROIT, MICH.—Preparations are being made by the Detroit Sulphite Fiber & Paper Company, of Detroit, Mich., for the erection of an addition to its manufacturing plant, plans for which are being prepared by Albert Danielson, of Kalamazoo, Mich. The plant will be equipped for electrical operation throughout.

MARQUETTE, MICH.—Bids are being asked by the City of Marquette, Mich., for the construction of a dam at Silver Lake, twenty-four miles north of the city, in connection with the municipal electric-light plant. Plans and specifications can be seen at the office of Charles Retallic, superintendent.

STANDISH, MICH.—The local electric light plant is reported to have been purchased by Guy H. Winterstee and Bruce W. Garton. The new owners took possession of the plant Jan. 1, 1911.

CHISHOLM, MINN.—Sealed proposals will be received by the Board of Education until Jan. 24 for the construction, complete, including plumbing, heating and ventilating and electrical work, of a school building to be erected by the City of Chisholm. Separate proposals will be required as follows: (1) General contract; (2) plumbing; (3) heating and ventilating; (4) electrical work. Plans and specifications may be obtained from C. E. Bell, Tyrie & Chapman, architects, 320 Auditorium Building, Minneapolis, Minn., for which a deposit of $50 will be required for each set, of which $40 will be refunded upon return of the plans. Plans and specifications are on file at the office of the Board of Education, Chisholm, Minn.; at the office of the architects and also at the Builders' Exchanges in Minneapolis, St. Paul and Duluth, Minn. B. R. de Lorimer is clerk of board.

MINNEAPOLIS, MINN.—Arrangements are being made by the Minneapolis General Electric Company for the erection of an electric plant to replace the one recently destroyed by fire. In the meantime a turbine and transformers will be installed temporarily on the ground in front of the ruins. The new station will be of steel and concrete construction and will cost about $750,000.

ST. PAUL, MINN.—Sealed proposals will be received at the office of the Chief Quartermaster, St. Paul, Minn., until Jan. 23 for electric-light supplies, plumbing supplies, hardware, etc., as per schedule, which together with information will be furnished on application. Major D. W. Arnold is quartermaster.

THIEF RIVER FALLS, MINN.—The City Council is considering the question of installing a municipal telephone system in Thief River Falls.

TOWER, MINN.—It is reported that the proposition to issue from $10,000 to $15,000 for the installation of a power plant at Pike River Falls to supply energy for the municipal electric plant will be submitted to a vote in February.

CHESTER, MONT.—Application has been made to the Council by L. D. Pugsley, president of the First State Bank of Chester, for a franchise to install and operate an electric light system in Chester.

COLUMBIA FALLS, MONT.—Plans are being made by James A. Talbot, of Butte, Mont., and associates for the construction of an electric railway to extend from Columbia Falls to Polson, work on which will begin in March.

CHADRON, NEB.—Messrs. Kass & Klingaman, who recently purchased the electric light plant of the Chadron Electric Light & Power Company, have been granted a twenty-year franchise by the City Council. It is understood that the new owners propose to make improvements to the system and install new machinery.

ATHENIA, N. J.—Sealed bids will be received at the office of the Secretary of Agriculture, Department of Agriculture, Washington, D. C., until Feb. 3, 1911, for furnishing and installing a storage battery at the United States Animal Quarantine Station, Athenia, N. J. James Wilson is Secretary of Agriculture.

BAYONNE, N. J.—The Bayonne Launch Company, recently incorporated with a capital stock of $10,000, is erecting a building 40 ft. x 60 ft. at the foot of Thirty-sixth Street and New York Bay, which will be equipped with modern wood-working machinery, operated by electricity. L. R. Schellenberger is secretary.

HOBOKEN, N. J.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 6, for an electric push button mail lift in the United States Post Office, Hoboken, N. J., in accordance with plans and specifications, copies of which may be obtained from the above office.

NEWARK, N. J.—The Gillette Safety Razor Company, of Boston, Mass., which purchased a tract of land on Frelinghuysen and Evergreen Avenues, Newark, N. J., is planning to erect a factory for the manufacture of frames for safety razors and safety razor blades at a cost of about $200,000. A 500-hp plant will also be installed.

PASSAIC, N. J.—The question of building a municipal electric-light plant in Passaic is under consideration.

HOPE, N. M.—The Hope Community Irrigation Company is planning to construct a large irrigation system and install pumping machinery on its land near Hope. About 20,000 acres will be reclaimed. C. M. Botts, W. P. Riley, H. M. Gage and W. J. Lewis are interested in the company.

BOLTON LANDING, N. Y.—A deal has been consummated between the Bolton Light & Power Company and Henry C. Knoblauch, president of the company, whereby the company becomes the owner of the electric-light plant and distributing system, which have been owned and operated by Mr. Knoblauch individually.

BUFFALO, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 31, for an electric push button freight lift in the United States Post Office at Buffalo, N. Y., in accordance with plans and specifications, copies of which may be secured at the above office or at the office of the custodian of the building. James Knox Taylor is Supervising Architect.

CORNING, N. Y.—The Public Service Commission, Second District, has authorized the Corning Gas & Electric Company, of Corning, N. Y., to exercise a franchise granted by the village of Painted Post to supply electricity for lamps and motors in that village.

EAST HAMPTON, N. Y.—The Public Service Commission, Second District, has authorized the East Hampton Electric Light Company to issue $13,500 in bonds, the proceeds to be used for equipment and improvements to its plant and distributing system.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has authorized Frederick W. Whitridge, receiver of the Union Railway Company, to enter into a contract with the City of New York to construct as an extension service line an electric railway, operated by an overhead trolley, along St. Ann's Avenue from Third Avenue to the Southern Boulevard.

ROCHESTER, N. Y.—Plans are being considered by the Rochester, Corning & Elmira Traction Company for the construction of an extension of its railway from Rochester to Danville, a distance of ninety miles, during the coming year.

SYRACUSE, N. Y.—Surveys are being made by the Syracuse & South Bay Electric Railroad Company for an extension of its railway from Syracuse to Watertown, a distance of about seventy-three miles.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company has been granted permission by the Public Service Commission, Second District, to issue capital stock to the amount of $1,750,000, the proceeds to be used to take up the promissory notes of the Syracuse Rapid Transit Company, amounting to $1,660,000, the remaining $90,000 to be used for extension and improvements to its property.

GREENSBORO, N. C.—Preparations are being made for the construction of a 10,000-hp auxiliary steam power plant in connection with the interurban electric railway. W. S. Lee, of Charlotte, N. C., is vice-president.

TROY, N. C.—The Smitherman Cotton Mills are now operating by electricity, which is obtained from the hydroelectric plant of the Smitherman Power Company, located at Little Whitney Falls, on Little River, six miles south of Troy.

FORT RANSOM, N. D.—The organization of a company to build an electric railway to connect Fort Ransom and Enderlin is under consideration.

STANLEY, N. D.—The City Council has granted a franchise to J. I. Moore, of Minot, N. D., to install and operate an electric-light plant in Stanley.

CANTON, OHIO.—The Illinois Central Electric Railway Company is planning to build an extension from Norris to Farmington, a distance of six and one-half miles, during the year 1911. George W. Chandler is chief engineer.

CINCINNATI, OHIO.—Mayor Schwab at a recent meeting of the Board of Control suggested that provisions be made for lighting the streets of Hyde Park, Avondale, Clifton and Evanston with electric lamps instead of gas lamps, as at present, and advised investigations be made as to cost, etc.

CLEVELAND, OHIO.—The Forest City Engineering Company, of Cleveland, is reported to have prepared plans for the erection of a four-story building to be erected at Clark Avenue and West Fortieth Street, Cleveland, for the Schultze-Ruck Delfs Shoe Company. A gas engine with a rating of 60 hp will be purchased and probably a generator to supply electricity for lighting.

STEUBENVILLE, OHIO.—Plans are being considered by the Tri-State Traction Company for extending its railway to Weirton.

ARDMORE, OKLA.—The Pioneer Telephone & Telegraph Company, of Oklahoma City, has taken over the management of the Chickashaw Telephone Company with principal exchange in Ardmore. It is understood that extensive improvements and extensions will be made in the Chickashaw plant. J. M. Noble is general manager of the Pioneer company.

MOUNTAIN VIEW, OKLA.—The Western Power & Irrigation Company, recently organized with a capital stock of $500,000, proposes to develop various water-powers. The first plant will be erected on the Washita River, where 650 hp will be developed, work on construction of which will soon begin. Electricity generated at the plant will be sup-

plied to the municipality of Mountain View and to farmers for pumping water for irrigation purposes. It is understood that contracts have been placed for construction of dam, machinery and equipment. C. T. Berryman is president; W. Holton Key, vice-president, and R. W. Poindexter, secretary. William L. Church, president of the Ambursen Hydraulic Construction Company, Boston, Mass., is consulting engineer. The main office of the company is located in the State National Bank Building, Oklahoma City, Okla.

BAKER CITY, ORE.—Arrangements are being made by the Baker Interurban Railway Company for the construction of its proposed electric railway to connect Baker City, North Powder and Eagle Valley, 100 miles in length, work on which will begin early in the spring. Anthony Mohr is promoter.

KLAMATH FALLS, ORE.—The Siskiyou Electric Power & Light Company, of Yreka, Cal., represented by A. C. Hough, attorney, has submitted a proposition to the City Council asking for a fifty-year franchise to erect transmission lines in Klamath Falls to supply electricity for lamps and motors to compete with the C. S. and R. S. Moore Company, which owns the local system. The Siskiyou company proposes to supply the service from its Falls Creek plant.

MEDFORD, ORE.—Preparations are being made by the Rogue River Electric Company for the construction of its new plant at Prospect, on Rogue River, next spring. The present plant located at Gold Bay, ten miles from Medford, has been found inadequate to supply the demands of the cities in the valley. High-tension transmission lines, carrying 66,000 volts, will be erected from the proposed plant to the cities in the Rogue River Valley, including Grant's Pass, Medford and Ashland.

PORTLAND, ORE.—It is reported that contracts have been placed by the Mt. Hood Railway & Power Company for electrical equipment for its new power house in Portland, consisting of four units having a rating of 3000 kw each. Preparations are being made by the company for the installation of two additional power plants.

PORTLAND, ORE.—Preliminary work is being done by the Portland Railway, Light & Power Company on the Upper Clackmas River, three miles above the Cazadero power station, where the company proposes to erect a large generating plant at a cost of $1,400,000. The work will include the construction of a gravity type concrete dam, 160 ft. in height and 750 ft. long across, with a head of about 135 ft. The power house will be located immediately below the dam.

PORTLAND, ORE.—Plans are being prepared by the Pacific Power & Light Company for extensive improvements and extensions to its systems throughout the Pacific Northwest, which will involve an expenditure of about $1,500,000. The company proposes to extend its transmission lines in connection with the irrigation system in the Columbia, Yakima and Walla Walla valleys to supply electricity to operate the pumps for irrigating purposes. The company already has a heavy irrigation pumping load and expects to double it by the end of the present year. It already has under way an extension of seventy miles of 66,000-volt transmission line from Kennewick to the Hanford Irrigation & Power Company's power house at Priest Rapids, on the Columbia River, and will erect about fifty miles of 6600-volt distributing system extending from the Milwaukee crossing on the Columbia River at Beverly to Hanford, Wash. Distributing lines are being erected from the high-tension lines at Sunnyside and Toppenish, and about twenty miles of high-tension and distributing lines are being erected from Freewater westward, serving a large irrigated district in that vicinity. The company is rebuilding the White River plant south of The Dalles at a cost of about $50,000; erecting a new substation at Walla Walla to cost about $50,000, and proposes to install a 1000-hp generator at the Walla Walla River plant and new substations at Touchet, Toppenish, North Yakima, Richland, Hanford, White Bluffs, Benton City and Beverly. Plans are also being considered to increase the output of the plant at The Dalles.

VALE, ORE.—Surveys have been completed by the Farmers' Electric Railway Company for its proposed electric railway to connect Vale and Malheur Canyon, sixteen miles in length. It is expected that the railway will eventually be extended to Ontario, Ore. G. W. Thomas, of Ontario, Ore., is president.

PANAMA.—Sealed proposals will be received at the office of the assistant purchasing officer, Panama Railroad Company, 24 State Street, New York, N. Y., until Feb. 1, 1911, for furnishing eight four-ton electric cargo handling cranes. Drawing and specifications may be obtained upon application to the above office. Major Wendell L. Simpson is assistant purchasing officer.

PANAMA.—Sealed bids will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until March 30, 1911, for furnishing material and erecting emergency dams at the canal locks and for furnishing and delivering certain tools, equipment and spare and repair parts. Blanks and general information relating to this circular (No. 616) may be obtained at the above office or from the offices of the assistant purchasing agents at 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is General Purchasing Officer.

BEAVER FALLS, PA.—The Commercial Water Company is reported to be making preparations for the construction of a dam across Dry Run and erecting a pumping station for distributing the water thus impounded. It is possible that a hydroelectric plant may be installed. At present the city obtains electrical service from the Valley Electric Company, of New Brighton, Pa.

CONNEAUTVILLE, PA.—The installation of an electric light plant in Conneautville is under consideration. Application for a franchse to construct and operate an electric plant has been made to the Council.

ETNA, PA.—The Borough Council has instructed the borough clerk to advertise for proposals for the construction of a municipal electric-light plant. Provision was made to call off the building of the proposed plant in case the borough should be annexed to Pittsburgh. Post office address, Etna, R. F. D., Allegheny, Pa.

FRANKFORD, PA.—Application will be made Jan. 27 for a charter for a street railway, to be known as the Northeastern Street Railway Company, by George B. Atlee, Mayer Schamberg, Morris Ebert, W. L. Allen, Wilson Woelpper and others. The company proposes to construct an electric railway from Frankford Avenue and Bridge Street, in Frankford, Philadelphia, to the county line, or Poquessing Creek, passing through Bustleton, Somerton and Byberry.

HOMER CITY, PA.—Steps have been taken for establishing an electric-light plant in Homer City provided a franchise can be secured from the City Council. A company has been formed by J. A. Stokes, of the Blairsville Machine Works; W. P. Graff, cashier of the First National Bank, and C. A. Simons, superintendent of the Columbia Plate Glass Company, all of Blairsville. The company has purchased a site in Homer City, on which it expects to erect an electric plant and an artificial ice plant.

JOHNSTOWN, PA.—The Johnstown & Altoona Railway Company is planning to build an extension of its railway from South Fork to Altoona, calling for the construction of thirty-two miles of track.

KOPPEL, PA.—The Orenstein-Arthur Koppel Company is reported to have taken bids for the erection of the new buildings for its works at Koppel, Pa., including a wood-working shop, machine shop, erection shop and heavy car shop. A separate power plant will be installed and there will be an outside crane runway, 40 ft. x 275 ft. The chief engineer of the company, Machesney Building, Pittsburgh, Pa., will have charge of the construction of the plant.

MANCHESTER, PA.—The Borough Council has granted the Manchester Electric Light Company a franchise to erect and operate an electric light plant in Manchester.

McKEESPORT, PA.—Plans are contemplated by the Pittsburgh, McKeesport & Westmoreland Railway Company for the construction of an extension of its railway from Blackburn to Herminie, a distance of three miles, during 1911.

PHILADELPHIA, PA.—Charles E. Wilson has been appointed receiver of the Continental Telephone & Telegraph Company in a suit brought by John E. Stevenson, a stockholder and creditor. The company was incorporated in 1909 with a capital stock of $50,000,000. Shortly after it was incorporated bonds to the amount of $25,000,000 were authorized. The only asset the company is said to have is the liability of the subscribers to the bond issue.

PITTSBURGH, PA.—William Flinn and Joshua G. Splane, both of Pittsburgh, have been appointed receivers for the Pittsburgh & Allegheny Telephone Company. The company has outstanding $4,000,000 in capital stock and bonds with a face value of $1,400,000.

BATESBURG, S. C.—The capital stock of the Delmar Telephone Company has been increased from $3,000 to $5,000.

CHARLESTON, S. C.—The City Council is reported to have authorized preliminary plans and estimates prepared for the construction of a municipal electric-light and pumping plant.

WATERTOWN, S. D.—It is reported that an electric light plant will be installed in Watertown at a cost of $200,000 before spring.

JACKSON, TENN.—Two propositions have been submitted to the City Council for improvements to the street-lighting system. One is an offer from the Jackson Railway & Light Company to purchase the equipment now owned and operated by the city for $2,000 and to furnish 150 arc lamps, such as are used at the present time, at the rate of $65 each per year. The other proposition is to remodel the municipal electric plant and purchase new machinery at a cost of about $16,000. It is estimated that the cost of operating the new plant would be about $6,000 per year. The plan submitted by the Jackson Railway & Light Company would cost over $9,000 per year.

KNOXVILLE, TENN.—The county courts of Blount and Monroe counties have granted the Tellico Power Company franchises to erect transmission lines from its plant at Tellico Plains along the pikes and highways into Knoxville. The company has already secured a franchise in Knox County. The plant when completed will have an output of about 6000 hp, which will be transmitted to Knoxville, where it will be used for operating factories, industrial plants, etc. John C. Knight, of Knoxville, is president of the company.

NASHVILLE, TENN.—The Nashville Railway & Light Company is contemplating extensions to its system this year which will call for the construction of about five miles of new track.

AUSTIN, TEX.—It is reported that important improvements and extensions will be made to the property of the Austin Street Railway Company, which was recently reorganized with a capital stock of $1,250,000. The new incorporators are: R. C. Story, of Boston, Mass.; William G. Bell and W. H. Folts, of Austin. The work includes the erection of a new power plant, the purchase of new rolling stock and other improvements to the service.

CLEBURNE, TEX.—It is understood that extensive improvements and

extensions will be made to the system of the Cleburne Street Railway Company during the year. The officers of the company are: Daniel Hewitt, president and general manager; A. M. Morgan, vice-president, and P. C. Coon, secretary and treasurer.

CRYSTAL CITY, TEX.—Arrangements are being made by Dr. E. S. Link, of Crystal City, for the construction of a furniture factory. An electric power plant will be installed to furnish electricity for operating the plant and for the irrigating pumps in this section.

FALFURRIAS, TEX.—The local electric-light and power plant, waterworks system and ice plant, owned by E. C. Lasater, of Falfurrias, is reported to have been purchased by G. W. Smith, of Cleveland, Ohio. It is understood that the new owner will make extensions and improvements to the systems.

FORT WORTH, TEX.—The City Council is considerinng the question of issuing $50,000 in bonds, the proceeds to be used for extensions and improvements to the munincipal electric light plant. The proposition will soon be submitted to a vote of the people.

HAMLIN, TEX.—The Hamlin Street Railway Company has been granted a franchise to extend its railway to the Central Nazarene University.

HASKELL, TEX.—Plans are being made by the Haskell Traction Company for the construction of an extension of its railway from Haskell to Rule, a distance of eleven miles, during 1911.

HOUSTON, TEX.—The Brown-Woods Electric Company, of Houston, has filed amendments to its charter, increasing its capital stock from $10,000 to $15,000.

LEAGUE, TEX.—The Galveston-Houston Electric Railway Company has awarded the contract for the construction of the power plant at League to the Stone & Webster Engineering Corporation, of Boston, Mass., to cost about $100,000. Contracts for machinery and equipment have already been placed.

MARBLE FALLS, TEX.—Charles Alexander and associates, who are erecting a dam across the Colorado River at Marble Falls and installing a hydroelectric plant, are reported to have prepared plans for the erection of another dam across the river near here, and a third one is contemplated, the latter to be located at Austin. Hydroelectric plants will be installed at each of the proposed dams. It is stated that contracts have been entered into to supply the cities of San Antonio, Waco and several smaller towns, situated within a radius of 100 miles of Marble Falls, with electricity for lamps and motors. Mr. Alexander is said to be now negotiating with the Municipal Commission of Austin to supply electricity in that city.

UVALDE, TEX.—The Uvalde & Leona Valley Interurban Railroad Company, which operates a railway between Uvalde and Sansom, contemplates extending the road to Batesville, a distance of twenty-five miles. The company now operates a gasoline motor car, and if the extension is made it is expected the railway will be equipped for electrical operation, which would necessitate the construction of a power plant and other improvements.

WEIMAR, TEX.—It is reported that the local electric light plant has been taken over by the Weimar Water, Light, Ice & Cold Storage Company, recently organized. It is understood that the new company will enlarge the plant and install new machinery. The company will also install water-works system, ice factory and cold-storage plant. William H. Hillje is president of the company.

LOGAN, UTAH.—The City Council has decided to increase the price for electric lamps of 16 cp from ten cents per lamp per month to fifteen cents per month, the new rate to take effect from Jan. 1, 1911. The municipal plant has been in operation between six and seven years and has yet been quite self-supporting.

RUTLAND, VT.—Plans are being considered by the Rutland Railway, Light & Power Company for building an extension from Poultney, Vt., to Granville, N. Y., nine miles in length, during the coming year.

CENTRALIA, WASH.—The Twin City Light & Traction Company is reported to be contemplating extensive improvements to its system during the coming year which will involve an expenditure of about $100,000 and include the erection and equipment of a new power house.

COUPEVILLE, WASH.—It is reported that the Whidby Island Light & Power Company will soon begin work on the installation of an electric light plant and water-works system.

NORTHPORT, WASH.—Work has been commenced by the J. G. White Company on the development of 30,000 acres of upper Columbia River land, purchased recently by the company for $1,500,000. It is proposed to develop the water-power and erect a hydroelectric power plant and to build a sawmill and box factory.

SEATTLE, WASH.—The City Council has passed an ordinance authorizing bonds for public improvements, including the installation of cluster lamps on Westlake Avenue.

SEATTLE, WASH.—Plans are being made by the Seattle Electric Company for equipping the Madison Street line from Broadway east for electrical operation, which will be ready for operation in the near future. The company also proposes to erect a new cable house, to be located at Madison Street and Tenth Avenue, which will be operated by electricity.

SPOKANE, WASH.—The report submitted to the Council power plant committee on Jan. 4 by City Engineer Macartney and W. E. Moore, hydraulic engineer, states that the city cannot, as a business proposition, build a power plant to supply electricity for the up-river pumping station and for street lamps only, but must go into the wholesale and retail business in order to make the plant pay. It also states that if the city decides to build its own plant now is the time to take the necessary steps. It also further states that the city should decide at once what it proposes to do to reduce rates for electrical service, whether to contract with some company after bids are submitted or to bring in another company to supply electricity for lamps and motors on a long-term contract, and eventually purchase the company's plant. It is stated that the present City Council will turn over to the commissioners elected March 7 under the new charter the question of building the municipal power plant for Spokane.

TACOMA, WASH.—The Island Railway & Navigation Company has applied to the City Commissioners for a franchise to build an electric railway on Sixth Avenue from Proctor Street, Tacoma, to the Narrows, a distance of three miles.

VANCOUVER, WASH.—The Oregon-Washington Corporation, recently incorporated with a capital stock of $5,000,000, has taken over the plant and holdings of the Vancouver Water Works Company, the Vancouver Traction Company and the Vancouver Gas Company. It is understood that B. M. Atkins, the present manager of the Vancouver Traction Company, will have charge of the Vancouver holdings for the company.

YACOLT, WASH.—Arrangements are being made by the City of Yacolt for the construction of a dam and pipe line at Big Tree Creek, which will be used to convey water to this city. The City Council has passed an ordinance granting the Yacolt Light & Power Company a franchise for joint use of the dam, where the city takes its water supply, to be used in connection with its power plant.

HUNTINGTON, W. VA.—The J. F. Johnson Company is reported to be making arrangements to construct a saw mill and power plant in Huntington.

WHEELING, W. VA.—The Pan Handle Traction Company is planning to extend its system from Wheeling to Glennova, a distance of three miles, during the coming year.

WHEELING, W. VA.—The power house of the Lorain Coal & Dock Company, located four miles east of Blaine, Ohio, was destroyed by an explosion, causing a loss of about $10,000.

BARABOO, WIS.—A company has been organized under the name of the Merchants' Power & Light Company to establish an electric plant in Baraboo. It is proposed to utilize the water-power from the dam under the Oak Street Bridge to generate electricity for a day service for motors and possibly for lamps. James Dickie, George McArthur, Sr., and George McArthur, Jr., are interested in the company.

BAYFIELD, WIS.—It is reported that plans have been prepared for the erection of a new boiler house in connection with the municipal electric light and pumping plant in Bayfield.

KAUKAUNA, WIS.—The Thilmany Pulp & Paper Company is reported to be preparing to construct a new factory which with equipment will cost about $250,000. The mill will be equipped for electric motor drive throughout.

MILWAUKEE, WIS.—It is stated that bids will be received for the construction of a new factory for the Hummel & Downing Company in Milwaukee, including power and coal-handling plant.

MILWAUKEE, WIS.—The Bradley Knitting Company is enlarging its factory and doubling its power equipment. The plant when completed will have an output of 225 kw and will supply electricity to light and operate its factory. The company utilizes the exhaust steam for heating by the vacuum system.

NEW LISBON, WIS.—At an election held recently the proposition to install a municipal electric-light plant was carried.

NORTH MILWAUKEE, WIS.—Plans have been prepared by the Home Brewing Company for the erection of new buildings, including power plant, refrigerating system, etc., to be erected in North Milwaukee.

SHERIDAN, WYO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 27 for furnishing and installing light fixtures in the United States public building at Sheridan, Wyo. James Knox Taylor is Supervising Architect.

PENTICTON, B. C., CAN.—At an election held Dec. 27 the rate payers voted in favor of the by-law to appropriate $71,000 for the installation of a municipal electric light plant for the town. Power for operating the plant will probably be obtained from Ellis Creek, a report having been prepared by F. H. Latim, municipal engineer. It is expected that work on construction of the proposed plant will begin this month.

WINNIPEG, MAN.—The consulting board of power engineers has recommended to the Board of Control that cable conduits be installed on Main Street and Portage Avenue, at a cost of $55,000, this year.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has been granted a permit by the city to erect a new power plant on Mill Street to cost about $72,000. The proposed new plant will have an output of 12,000 hp and when completed will involve an expenditure of about $500,000. Wilford Philips is general manager and chief engineer.

BRANTFORD, ONT., CAN.—Application is being made for the incorporation of the Lake Erie & Northern Railway Company to construct and operate an electric railway from Port Dover, Simcoe, Waterford, Brantford, Paris, Glenmorris, Ayr and Galt and also to supply electricity for lamps and motors. The cost of the proposed railway from Brantford to Port Dover is estimated at $800,000, and work will begin on construction

of the road if the various municipalities through which it will pass will guarantee the interest on the bonds of the company. From Brantford to Galt, in order to secure connection with the Canadian Pacific Railway at the latter place, the Grand Valley Railway will be rebuilt, or an entirely new road constructed. The incorporators are: Lloyd Harris, M. P.; W. S. Brewster, W. P. Kellett and John Muir, of Brantford.

HESPELER, ONT., CAN.—The by-law to appropriate $4,000 for extensions of the electric street-lighting system was carried at the election held recently.

LISTOWELL, ONT., CAN.—At an election held Jan. 2 the by-law to raise $5,000 to complete the electric light system was carried.

NORTH TORONTO, ONT., CAN.—At an election held Jan. 2 the by-law to appropriate $18,000 for an electric light plant was carried. E. A. James, of Eglinton, Ont., is engineer in charge.

OTTAWA, ONT., CAN.—Announcement has been made that the rates charged for electricity for lamps from the municipal electric plant will be reduced from 10 per cent to 15 per cent.

PRESCOTT, ONT., CAN.—The Aluminum Company of America, controlled by the Mellon family, of Pittsburgh, Pa., is reported to have purchased 3500 acres of land, including Bernhart's Island, in the St. Lawrence River, below Prescott, where it proposes to construct a plant to develop 300,000 hp. It is said that if permission is secured to erect a plant the company is prepared to expend $40,000,000 on the project.

STRATHROY, ONT., CAN.—The rate-payers, on Jan. 1, voted in favor of the by-law authorizing an expenditure of $6,000 for improvements to the municipal electric light plant and water-works system.

TORONTO, ONT., CAN.—The City Council has entered into an agreement with the Toronto Electric Light Company to extend the street lighting contract, which expired Dec. 31, for two months, at which time the city expects to be in a position to put the municipal electric lighting system in operation, electricity for which will be supplied by the Hydro-Electric Power Commission. The city pays the company $69 per arc lamp per year.

TORONTO, ONT., CAN.—Announcement has been made that the loop connecting St. Mary's and London has been completed and power turned on. The completion of this section gives a double transmission circuit through all the municipalities north and west of Dundas. The line from Niagara Falls to Dundas already has a double circuit, which gives the entire line from the Falls to St. Mary's, the present terminus of the Hydro-Electric Power Commission's main line, a double circuit.

MONTREAL, QUE., CAN.—The Shawinigan Water & Power Company is reported to have purchased a large tract of land in Maisonneuve, Montreal, in connection with the enlargement of its terminal station. J. E. Alfred is president of the company.

MONTREAL, QUE., CAN.—The Montreal & Southern Counties Railway Company is contemplating building an extension to the new "country club," St. Lambert, calling for two miles of track and the construction of an extension to connect Chambly Basin, Chambly Canton and Richelieu, a distance of thirteen miles, during the coming year.

VALLEYFIELD, QUE., CAN.—It is reported that the Montreal Cotton Company has purchased the plant of the Valleyfield Electric Company for a consideration of $80,000.

GUANAJUATO, MEX.—It is reported that arrangements are being made by a French syndicate, represented by E. Brunel, French consular representative at Irapuato, Mex., for the construction of an extensive system of interurban electric railways in the State of Guanajuato. It is understood that the syndicate is negotiating for the purchase of the street railway system in the State of Guanajuato, an offer of $500,000 in Mexican currency having been made to Governor Obegan Gonzales, principal owner of the property. The syndicate is reported to have already acquired the concession for the construction of the Morelia & Tacambaro Railway, for which the grade is partly finished. Mr. Brunel and associates propose to construct an electric railway system to connect the cities of Leon, Guanajuato and Irapuato. More than sixty miles of track will be built, exclusive of the street railway systems in the three cities, which the syndicate is arranging to control. The syndicate pledges itself to expend not less than $4.000,000 in gold in connection with the project.

New Industrial Companies.

THE DIXIE ELECTRIC COMPANY, of Montgomery, Ala., has been incorporated with a capital stock of $12,000 by Clarence N. Jones, Hopson Owen and W. H. Crump. The company proposes to manufacture and deal in electrical supplies.

THE ELECTRIC APPLIANCE COMPANY, of Toledo, Ohio, has been chartered by Mark Knabenshue, M. V. Girkins, Wesley S. Thurston, Jr.; George E. Seney and Francis E. Smith. The company is capitalized at $10,000 and proposes to deal in and sell all kinds of electrical appliances and machinery.

THE ENTERPRISE ELECTRIC FIXTURE COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $10,000 by A. Oppenheimer, Edward Younger and others.

THE FALK-McMAHON WIRELESS COMPANY, of New Orleans, La., has been organized by Hilbert Falk and others. The company proposes to establish a plant to manufacture a patented wireless telegraph machine invented by Mr. Falk.

THE E. A. FOY COMPANY, of Cincinnati, Ohio, has been chartered by E. A. Foy, Mary A. Foy, William R. Foy, R. E. Heekin and C. T. Burdge. The company is capitalized at $75,000 and proposes to manufacture lightning rods and electrical appliances.

THE GAS & ELECTRIC FURNACE COMPANY, of Denver, Col., has filed articles of incorporation with a capital stock of $200,000. The incorporators are: W. W. Linninger, J. C. Pelton and C. C. Donaldson, all of Denver, Col.

THE GRAVITY RAILWAY SIGNAL COMPANY, of Richmond, Va., has been incorporated with a capital stock of $500,000 to manufacture automatic electrical or mechanical railway signals. The officers are: W. H. Woody, Jr., president; C. G. Burton, vice-president, and William H. Campbell, secretary and treasurer.

THE LA POINTE ELECTRICAL COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $25,000 by F. A. La Pointe, G. Fallon and J. J. Fallon, all of Hoboken, N. J. The company proposes to deal in electrical supplies.

THE MODERN ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $5,000 by S. J. Deutsch, F. Bernstein and S. J. Rothschilds.

THE MOTOR CAR MANUFACTURING COMPANY, of Indianapolis, Ind., has been incorporated by William C. Teasdale, Jr.; F. C. Dorn and G. O. Simons. The company is capitalized at $75,000 and proposes to manufacture automobiles and other power-propelling vehicles, parts and supplies.

THE NATIONAL ELECTRIC COMPANY, of Baltimore, Md., has filed articles of incorporation with a capital stock of $2,500 for the purpose of doing an electrical engineering business. The incorporators are: Charles B. Mills, 1811 Ashburton Street; B. B. Shreeves, 130 Law Building; Charles Schmidt and William P. Schmidt, all of Baltimore, Md.

THE PEORIA ELECTRIC FIXTURE COMPANY, of Peoria, Ill., has filed articles of incorporation with a capital stock of $2,400. The company proposes to manufacture and deal in electric fixtures, supplies, etc. The incorporators are: E. J. Abercool, John L. Palmer and A. G. Walsh.

New Incorporations.

VAN BUREN, MAINE.—Articles of incorporation have been filed for the Van Buren Light & Power Company with a capital stock of $50,000. The company proposes to supply electricity for lamps, heat and motors in the towns of Van Buren and Hamlin. Levito V. Thibadeau is president, and Joseph Martin, treasurer, both of Van Buren.

LEE'S SUMMIT, MO.—The Lee's Summit Light, Power, Ice & Storage Company has been incorporated with a capital stock of $20,000 by Charles N. Hanks, L. H. Morris, John H. Cook and others.

ST. LOUIS, MO.—The Ozark Power & Water Company has been incorporated with a capital stock of $5,000 by R. W. Morrison, Chester E. Berg and Frank Mottbusch.

PLYMOUTH, N. C.—The Plymouth Light & Ice Company has been chartered with a capital stock of 25,000 by A. L. Owens, C. L. Owens and Clarence Latham.

WARRENTON, N. C.—The Warrenton Electric Light Company has been chartered with a capital stock of $25,000 to construct and operate an electric light plant in Warrenton, N. C. The incorporators are: W. L. Rogers, J. W. White, H. J. Bradley, Frank Seus and R. J. Jones.

COLUMBUS, OHIO.—The Columbus Electric Company has been chartered with a capital stock of $125,000 by W. S. Smith, W. F. Felton, T. W. Wolfrey, J. M. Davis and E. B. Taylor.

AUBURN, PA.—The Auburn Electric Light, Heat & Power Company has been granted a charter with a capital stock of $15,000. The directors are: F. J. Voss, of Auburn, Pa., treasurer; W. D. Burch, of Selinsgrove, Pa., and Horace H. Binkley, of Auburn, Pa.

Personal.

MR. SAMUEL INSULL returned to Chicago on Jan. 14 after a holiday trip to England.

MR. ANGUS S. HIBBARD, vice-president and general manager of the Chicago Telephone Company, has been elected president of the Wisconsin Society of Chicago.

MR. HENRY P. RUST read a paper on January 12 at the Brooklyn Engineers' Club having for its subject the Feather River hydroelectric plant of the Great Western Power Company.

MR. C. L. CROSBY, formerly manager for Crosby, Craft & Company, Cleveland, Ohio, which firm was dissolved Dec. 31, 1910, has accepted a position as district sales manager for Machado & Roller, with headquarters in the Oliver Building, Pittsburgh.

MR. W. A. LADUE has been appointed division superintendent of the Hudson division of the Public Service Electric Company, of Newark, N. J., succeeding Mr. H. D. King, who was connected with the company for ten years. Mr. Ladue will be stationed at Hoboken, N. J.

MR. W. R. PUTNAM has resigned as superintendent of the Menominee & Marinette Light & Traction Company, of Marinette, Wis., effective Feb. 15. Mr. Putnam has been with the company since February, 1909, having been formerly manager of the Red Wing Gas, Light & Power Company, of Red Wing, Minn.

MR. RALPH HAWKINS, formerly superintendent of the Ogdensburg Electric Light & Power Company, has been appointed general manager of the Patchogue Electric Light Company. Mr. Jesse C. Mills, formerly general manager, was presented upon retirement from that position with a handsome gold watch by the board of directors.

MR. AUSTIN E. GIBSON has been appointed local manager of the light and traction properties of the Michigan United Railways at Owosso and Corunna, Mich. Mr. Gibson was at one time operating engineer of the Mexican Light & Power Company and was also in charge of the electrical work of a number of copper companies in Arizona.

MR. G. N. LEMMON, who formerly represented Sanderson & Porter, of New York, in construction and power-house work for the Youngstown & Shenango Railway & Light Company and was later made superintendent of overhead lines of the company, has been appointed electrical engineer of the Michigan United Railways, with headquarters at Jackson, Mich.

MR. R. N. DICKINSON, formerly engineer on the staff of the general superintendent of the Public Service Electric Company, of Newark, N. J., has been appointed assistant superintendent of the Hudson division of the company. Mr. Dickinson, who will be stationed at Jersey City, succeeds Mr. W. A. Ladue, whose promotion is noted elsewhere in this column.

MR. N. M. ARGABRITE, manager of the Public Service Operating Company, of Belvidere, Ill., has resigned his position with that company to enter the service of the American Gas & Electric Company, of New York City. Mr. T. C. McKeen, who has filled the position of assistant manager under Mr. Argabrite, will succeed to the position of manager at Belvidere, Ill.

MR. C. H. BROWARD has been retained as superintendent of the new 24,000-hp hydroelectric plant on the Ocmulgee River, Georgia. This plant belongs to the system of the Central Georgia Power Company, of which Mr. J. J. Cagney, of Macon, Ga., is general manager. Mr. Broward has been connected with the Southern Power Company system, having had supervision of two of its large hydroelectric developments.

DR. EDWIN F. NORTHRUP showed a large collection of unique instruments and lantern slides at the Brooklyn Academy of Arts and Sciences Jan. 9 and lectured upon the subject of "New Devices for Electrical Measurements." Several of the instruments were shown in operation, among others the Vreeland oscillator and the Brooks deflection potentiometer and an autographic temperature recorder.

MR. W. S. GRAHAM, formerly Surveyor-General of California and member of the engineering corps during the construction of the Southern Pacific Railroad, has been appointed general superintendent of the Snow Mountain Water & Power Company, with headquarters at Ukiah, Cal. The company is planning extensive improvements to its system, and these will be under the direction of the newly appointed superintendent.

MR. LEWIS S. CURT, of the export department of the Federal Electric Company, was appointed a member of the foreign trade committee of the Chicago Association of Commerce at a recent meeting of the board of directors. This committee is organized for the purpose of increasing the commerce of Chicago with foreign markets, and Mr. Curt was selected for membership on account of his experience in connection with Spanish-American export trade.

MR. H. THURSTON OWENS has been appointed associate editor of the *American Gas Light Journal,* 42 Pine Street, New York City. Mr. Owens, who has been connected with the lighting industry for the past ten years and has been a frequent contributor to the technical press, is a member of the American Gas Institute, National Commercial Gas Association, New York Electrical Society, Illuminating Engineering Society and a corresponding member of the British Illuminating Engineering Society.

MR. THOMAS A. EDISON was elected an honorary member of the Engineers' Club of New York last week, and at the same time the same distinction was conferred on Rear-Admiral Melville, who attained his seventieth year on Jan. 10. The only other honorary members of the club are Andrew Carnegie and John Fritz, the Nestor of the steel industry in America. Both Mr. Edison and Admiral Melville have been members of the club for many years. The official letter to Mr. Edison speaks of his achievements as an inventor and his great contributions to engineering and industry.

PROF. DUGALD C. JACKSON has been retained by the British government as telephone expert in connection with the appraisal of the property of the National Telephone Company, which is to be purchased by the English Post Office Department at the expiration of the company's thirty-one-year license on Dec. 31, 1911. Professor Jackson, as a member of the firm of D. C. & W. B. Jackson, consulting engineers, Boston and Chicago, sailed for England on the Lusitania Jan. 18 for a week's preliminary conference with the British Post Office officials in connection with the valuation of the telephone property of the National company, which includes over 1500 exchanges and over 500,000 subscribers, the capitalization of the system being about $60,000,000. The purchase of the telephone system by the government will involve a valuation of the equipment with special reference to its availability for service as a part of the royal system of telephones which after next year will cover practically all the telephone service in the British Isles.

Obituary.

MR. WILLIAM H. BROWNE died in Brooklyn, N. Y., Jan. 14, of exhaustion due to cancer. Mr. Browne was born at Troy, N. Y., Dec. 3, 1849, and in 1888, shortly after entering the electrical field, became connected with the construction of the Richmond (Va.) electric railway, the first commercial road in this country. Shortly afterward he became associated with the Westinghouse interests in New York City, and as general manager of the United Electric Light & Power Company was in charge when the first alternating current system (2000 volts) was installed for lighting purposes. From New York Mr. Brown went to Montreal, Que., where he took charge of the Royal Electric Company. In 1897 the Chambly Manufacturing Company, under Mr. Browne's direction, began the development of hydraulic power on the Richelieu River at Chambly Rapids to furnish power for Montreal. The following year he completed the works of the Cataract Power Company at Hamilton, Ont. He later turned over to the Canadian General Electric Company the manufacturing business of the Royal Electric Company, which had been built up under his management. The consolidation of the Chambly Manufacturing Company, the Royal Electric Company and the Montreal Gas Company, under the name of the Montreal Light, Heat & Power Company, Mr. Browne's last work in Canada, completed the largest industrial organization in the Dominion. On Jan. 31, 1902, he resigned his position as head of the new company to become general manager and treasurer of the Stanley Instrument Company at Great Barrington, Mass. Five years later the Stanley works were merged with the General Electric Company and Mr. Browne opened offices in New York as a consulting engineer. When taken ill he was engaged in carrying out the hydroelectric development of the Rockingham Power Company in North Carolina. Mr. Browne was a widower and leaves five children—Mrs. A. P. Ryan, Mrs. W. Harry Sefton, Miss Mary Browne, W. H. Browne, Jr., and Maurice J. Browne, all of New York. He was a member of the American Institute of Electrical Engineers, of the St. Lawrence, Montreal and Catholic clubs, and was a past grand master of the Knights of Columbus.

Trade Publications.

FUSES AND CUT-OUTS.—The D & W Fuse Company, Providence, R. I., has issued Catalog No. 12 of its well-known non-arcing fuses and safety devices for lighting, heating, motor, railway, signal, telephone and telegraph circuits.

ELECTRICALLY HEATED APPARATUS.—The Manhattan Electrical Supply Company, New York, has isued a circular giving excellent illustrations, with descriptions, of a long line of electric cooking and other heating apparatus.

VENTILATION AND HEALTH.—Warren Webster & Company, Camden, N. J., have reprinted in pamphlet form Mr. W. G. Snow's lecture on "Ventilation in Its Relation to Health," delivered in the course on sanitary science and public health at Cornell University, May 24, 1910.

COAL-WASHING INSTALLATIONS.—The Link-Belt Company, Philadelphia, Pa., one of whose specialties is a modern method of treating and handling coal, to the end that the quality of the various grades may be improved, has issued a pamphlet describing the progress in constructing a recent installation of coal washeries at Dunkirk, Kan.

ELECTRIC HEATING PAD.—The H. W. Johns-Manville Company, New York, has issued a booklet entitled "Heat as the Family Doctor," enumerating various ills which may be cured by hot applications. The point emphasized is the necessity of a permanent and uniform heat, which can, of course, only be obtained from an electric heating pad. A list of "J-M Electrotherm" apparatus is included.

WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing a series of bulletins showing the various elements of its mercury flotation ampere-hour and watt-hour integrating meters. The detailed drawings which illustrate the non-spillable mercury chamber should prove of interest to meter superintendents and constitute an interesting contribution to meter literature.

GARBAGE DESTRUCTOR.—The Power Specialty Company, New York, manager of the Destructor Company, has issued a pamphlet containing descriptions and tests of the Milwaukee garbage destructor, West New Brighton (N. Y.) destructor and the destructor at Westmount, Quebec, Canada. A list of installations of Heenan or Meldrum destructors, the steam from which is used for generating electricity for pumps, is appended.

STORAGE BATTERY.—The "Ironclad-Exide" battery for vehicles is described in a booklet issued by the Electric Storage Battery Company, of Philadelphia. In this battery the positive plate consists of metal top and bottom bars connected by vertical conducting rods. Each rod is surrounded with active material, which is protected and held firmly in place by a slotted hard-rubber tube. Each tube carries a vertical rib on each side, and these ribs take the place of the ribs of the wood separators as well as the perforated rubber-sheet separators used with the Exide type of positive plate. A thin flat-wood separator is placed between the positive and negative plates in the new battery. The negative plate is a modified Exide plate somewhat thickened to give it increased capacity.

BUSINESS NOTES.

THE MOLONEY ELECTRIC COMPANY, of St. Louis, Mo., is reported to be making arrangements for establishing a branch factory at Windsor, Ont., for its Canadian trade. The company is said to have orders amounting to $500,000 on hand.

CATALOGS WANTED.—The E. S. Downs Company, electrical engineer and contractor, Newark, N. J., has opened an office in the Firemen's Building in that city and would like to receive catalogs, price-lists, discount sheets, etc., relating to electrical apparatus, fittings, supplies, etc.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has opened a St. Louis office and warerooms at 1120 Pine Street, which will be in charge of Mr. W. L. Cummiskey, who for some years was with the Jandus Electric Company and until recently its Western manager, with headquarters at Chicago.

THE HABIRSHAW WIRE COMPANY, New York, has received orders for rubber-covered wire that will be used throughout the new Vanderbilt Hotel, Thirty-fourth Street and Park Avenue, New York; the Bankers' Trust Company Building, Wall Street, New York, and the new building of the Harris Trust Company, Chicago.

THE KILBOURNE & CLARK COMPANY, one of the oldest established electrical machinery and engineering firms on the Pacific Coast, with headquarters at Seattle, Wash., has disposed of its business to George B. Adair & Son Company. Mr. Frederick G. Simpson, formerly secretary and chief engineer of the Kilbourne & Clark Company, has been appointed general manager and chief engineer of the Kilbourne & Clark Manufacturing Company, with factory and principal offices at Seattle, Wash. The plant of the Kilbourne & Clark Manufacturing Company manufactures rotary converters and transformers for wireless telegraph purposes, storage batteries and switchboards.

GIROD ELECTRIC FURNACES.—C. W. Leavitt & Company, 307 Church Street, New York, which company represents in this country the Girod electric furnace, state that the furnace of this type installed by the Simonds Manufacturing Company at Chicago is being transferred to that company's new and modern plant at Lockport, N. Y., where it will be utilized for refining the high grade of steel required for saws, machine knives, files, etc. At a plant in Ugine, France, six Girod electric furnaces are now in operation, and a new 8000-kw furnace is being installed. The Girod furnaces are also used by the Cockerill Company in Seraing, Belgium, and by the Krupp Company, of Eston, which is now installing a 12½-ton furnace of this type, to be operated with three-phase currents.

THE DEARBORN DRUG & CHEMICAL COMPANY has established a branch office and warehouse in Manila, P. I., with F. O. Smote in charge, under the supervision of E. C. Brown, manager of the foreign department of the Dearborn company. Mr. Smote has been connected with mining since his graduation in chemistry from the University of Illinois in 1891, and Mr. Brown has spent most of the past two years in Japan, China and the Philippines investigating steam plant and railroad conditions in the interests of Dearborn products and has established selling connections in Tokyo, Tientsin, Honolulu and Shanghai. The Dearborn company during the past two years has worked up a considerable business in connection with feed-water treatment and lubricants in the Philippines.

THE PAUL STEWART COMPANY has been organized in Cincinnati to deal in electrical apparatus, engines, boilers, etc. The company has purchased five acres of ground at Red Bank, on the Pennsylvania Railroad, on which the first building, a steel and concrete structure, 100 ft. by 54 ft., to be used as a shop and warehouse, has already been erected. The Cincinnati office will be in the First National Bank Building. Mr. Paul Stewart, who has for the past ten years been connected with the John A. Stewart Electric Company, is president of the company; Mr. George W. Gano, a pioneer of the electrical field dating from the days of the Thomson-Houston Company, is vice-president and treasurer, and Mr. Colter Rule, for the past year secretary of the Interurban News Distributing Company, is secretary.

SANGAMO NEW YORK OFFICE—The increasing business of the Sangamo Electric Company, Springfield, Ill., has necessitated opening an office in New York City, which has been placed in charge of Mr. M. B. Chase, previously in the Boston office of the Westinghouse Electric & Manufacturing Company. The Sangamo products now embrace a complete line of alternating-current and direct-current watt-hour meters, ampere-hour meters for stationary battery and vehicle work, portable and switchboard type of graphic recorders. A complete line of indicating instruments, both portable and switchboard forms, has been designed and will be offered for sale within a few months. The New York office will be fully equipped from both an engineering and sales standpoint, so that a large part of the work, especially that for devices to meet special conditions, formerly referred to the factory will be handled direct from New York. A new factory is practically completed at Springfield, which will enable the Sangamo company to take care of its very rapidly increasing business.

ANDRAE BUILDING, MILWAUKEE, DESTROYED BY FIRE.—The large six-story building at 118-120 Sycamore Street, Milwaukee, occupied by the electrical supply and machinery stock of the Julius Andrae & Sons Company, was completely destroyed by fire on Saturday evening, Jan. 7. The fire started in the machine shop on the third floor, and the destruction of the building and its contents was rapid and spectacular. The Andrae company valued its stock, comprising electrical supplies and machinery of all kinds, at $150,000, while the loss on the building, of which it was the tenant, will reach $50,000. These losses are covered by insurance. Immediately following the fire new quarters were opened by the company near the site of the destroyed building, and the company was only interrupted a day or two in filling orders. Mr. Julius Andrae, a pioneer in the electrical supply field, recently celebrated the fiftieth anniversary of his business, which is now conducted by his three sons. As the company lost many of its records, it will appreciate it if manufacturers will forward catalogs and trade literature to replace the burned collection. company will be largely in connection with electric lighting, transaction and industrial power work.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 10, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

980,912. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 28, 1907. A plural lamp holding device with insulating base, center contacts, threaded shells, a plate with grooves to receive the shells for locking them in position.

980,913. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 14, 1908. A supporting member, an insulating base extending beyond the support, a plate on the upper side, a bayonet connection between the plate and support and lamp holder and contact carried by the vase.

980,921. LOADED PHANTOM CIRCUIT; G. A. Campbell and T. Shaw, Brooklyn, N. Y. App. filed Feb. 12, 1910. Two-line circuits associated to furnish a phantom or third circuit and a loading coil for the phantom circuit, comprising sectional windings in both component lines, the admittances between each sectional winding and the other elements of the coil being symmetrically distributed.

980,926. TWO-BUTTON PENDENT SWITCH; F. C. De Reamer, Schenectady, N. Y. App. filed Oct. 2, 1907. Two-button drop switch with body of insulation having a slot and lips binding posts secured to upper end of the body, and a sheet of insulation having slits in its ends to form tongues adapted to engage the lips.

980,940. ELECTRIC INDUCTION FURNACE; C. Grunwald, Bredeney, Germany. App. filed April 20, 1909. An auxiliary winding for counteracting the repelling effect of the primary winding upon the melting bath, with means for preventing the current in the auxiliary winding from influencing the equilibrium of the bath.

980,945. ELECTRICAL BINDING POST; W. Hector, Chicago, Ill. App. filed Feb. 27, 1908. Sheet metal blank with solid filling and binding posts.

980,979. ELECTRICAL REGENERATIVE CONTROL APPARATUS AND SYSTEM; J. C. Macfarlane and H. Burge, Arc Works, Chelmsford, England. App. filed Feb. 7, 1910. A motor generator with a pair of motors in series with each other and with the generator and a reversible shunt for controlling the field of the generator together with constant excitation upon the pair of motors and auxiliary shunt winding connecting the pair and one supply main.

980,986. ALTERNATING-CURRENT ELECTRIC MOTOR; H. S. Meyer, Bremen, Germany. App. filed Aug. 22, 1906. A rotor with laminations having slots carrying a distributed winding and bars of magnetic material in the laminations below the slots and short-circuited.

981,004. ELECTROPLATING APPARATUS; M. Reid, Cleveland, Ohio. App. filed Feb. 19, 1906. A central anode surrounded by a cage, a cathode surrounding the anode and extending from the lower portion of the tank as high as the anode.

981,012. ELECTRIC CONTACT; A. Schweiger, Itzling-Salzburg, Austria-Hungary. App. filed April 8, 1909. Insulator with two current conductors and two electrically conducting arms suspended from the current supplying conductors so as to be in electrical connection therewith and two upwardly extending projections integral with the arms carrying an insulator which receives the free ends of the wires, which are inclosed by a tube secured to the insulator.

981,015. PHANTOMED LOADED CIRCUIT; T. Shaw, Hackensack, N. J. App. filed Feb. 12, 1910. Line circuits forming a third or phantom circuit with a loading coil in each component, each coil having a core and winding thereon symmetrically arranged to minimize the magnetic leakage resulting from operating currents in the phantom circuit.

981,020. FIRE ALARM; F. D. Smenner, Fort Wayne, Ind. App. filed Sept. 9, 1908. Controlled by a weighed cord and weighed triggers.

981,027. CONNECTOR FOR ELECTRIC CONDUCTORS; G. E. Stevens, Lynn, Mass. App. filed April 1, 1908. Socket terminal having elongated groove strips with springs pressing them together.

981,038. RENEWABLE FUSE FOR ELECTRIC CIRCUITS; J. A. Volk, Jr., South Norwalk, Conn. App. filed April 20, 1910. A non-conducting fuse body with end plates detachably secured thereto and having central holes and caps with screws engaging the holes.

981,057. ROTOR COIL RETAINER; A. J. Brown and R. B. Williamson, Milwaukee, Wis. App. filed April 8, 1910. A member with projecting poles and coils thereon bracing members for supporting adjacent sides of the coils and tie rods for fastening them together.

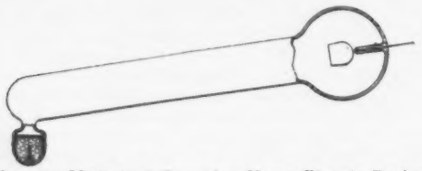
981,059. ROTARY CONVERTER; J. L. Burnham, Schenectady, N. Y. App. filed March 28, 1908. An armature with commutator and brushes, connections for supplying current to and from the armature, a field with poles surrounding the armature. Field magnet windings on the frame and connections for shifting the line of effective magnetization circumferentially with respect to the field by a variation in the relative current strengths in the windings.

981,063. SWITCH FOR ELECTRIC CIRCUITS; H. W. Cheney, Norwood, Ohio. App. filed Nov. 29, 1907. Circuit breaker with a reciprocating arm for opening and closing the contacts, one fixed and the other on a rotating drum within which a coil conductor is arranged which acts as a blow-out magnet.

981,074. SPLIT-KNOB INSULATOR; H. H. Dupont, Indianapolis, Ind. App. filed April 14, 1910. An insulator with two interlocking members for clamping the wires between them, which members are triangular in cross-section with wire grooves at each corner.

981,092. MAGNETIC SEPARATOR; A. Kuhn, Marchegg, Austria-Hungary. App. filed May 27, 1909. A drum having magnetic elements of Z-shape around the circumference and carried by non-magnetic spiders with annular retaining rings for the magnetic elements.

981,102. ELECTROLYTIC DEVICE FOR GENERATING PURE OXYGEN AND HYDROGEN; Wasquehal, France. App. filed Sept. 17, 1909. Electrodes with extensions having holes to form canals and a settling tank with means for draining off the impurities.



981,328.—Method of Operating Vapor Electric Devices.

981,118. SAFETY APPLIANCE FOR ENGINE GOVERNORS; H. R. Rockwell, Mount Vernon, Ill. App. filed May 31, 1910. For stopping the engine by means of an electric circuit brought into action by the governor at a certain speed.

981,120. TELEPHONE AND TELEGRAPH SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed June 26, 1908. For simultaneous telegraphy and telephony, two-line wires and selecting calling means, telephone instruments, telegraph instruments and means for preventing interference.

981,121. AUTOMATIC ARC LAMP; E. Sailer, Rochester, N. Y. App filed Nov. 3, 1905. Carbon feeding devices with rotatable extensions, an operating handle on each extension, one of the handles being movable axially relative to the other, a spring normally operated to hold the handles in co-operative relation and a detent arranged to engage the handle with a plunger adjacent to the handles co-operating with the detent.

981,129. PROCESS OF FORMING INSULATING TUBES; W. R. Seigle, Nashua, New Hampshire. App. filed Dec. 20, 1909. The method of forming tubes, which consists in distributing finely divided liquefiable hydrocarbon over a sheet of asbestos fiber, rolling the sheet into a tubular spiral, inclosing the hydrocarbon between its layers and heating the tubular body, liquefying and distributing the hydrocarbon in the mass.

981,134. ROTARY CONVERTER; C. P. Steinmetz, Schenectady, N. Y. App. filed March 20, 1909. The armature has a commutator and collector rings, main field poles, windings for varying the flux in the main poles so as to vary the relative voltages at the commutator and collector rings and unwound commutating poles at the points of commutation of the current flowing through the commutator.

981,141. MEANS FOR PRODUCING A VACUUM; P. H. Thomas, East Orange, N. J. App. filed Jan. 23, 1904. For exhausting a lamp by the action of vaporization by means of auxiliary expelling means which supplies an additional more easily volatizable liquid into the chamber prior to exhaustion.

981,155. LIQUID HEATER; H. E. Bandow, Chicago, Ill. App. filed Oct. 3, 1910. Heater with a reservoir and draw-off valve and an electrical heating unit in the base of the heater.

981,196. ELECTROPLATING APPARATUS; S. S. Jacobsen, Beaver, Pa. App. filed Feb. 15, 1910. A tank with right and left feeding screws below the solution for feeding the work through the tank and electrical connections to the screws.

981,197. SYSTEM OF ELECTRICAL DISTRIBUTION; J. W. Jepson, New York, N. Y. App. filed Aug. 29, 1905. A load circuit, a generator and storage battery for supplying the same and a booster to assist charging the battery with an automatic voltage regulator for the generator and circuit controllers therefor.

981,198. SYSTEM ELECTRICAL DISTRIBUTION; J. W. Jepson, New York, N. Y. App. filed April 30, 1906. A consumption circuit, a generator and storage battery connected therewith with a booster for charging the battery and a regulator for the generator voltage.

981,229. OPERATING MEANS FOR VAPOR ELECTRIC DEVICES; P. H. Thomas, East Orange, N. J. App. filed Feb. 10, 1904. A chamber contains a vaporizable liquid and is heated during normal operation of the mercury vapor apparatus and a second receptacle of large heat-radiating capacity is connected therewith, together with means for maintaining a difference in pressure between the two.

981,235. ELECTRIC METER; H. N. Atwood, Lynn, Mass. App. filed Aug. 20, 1908. An inverted cup-shaped mercury receptacle with an armature therein, a magnet with poles in operative relation with the sides and a second magnet with poles in operative relation with the top of the armature.

981,236. ELECTRIC METER; H. N. Atwood, Lynn, Mass. App. filed Aug. 20, 1908. A mercury meter with two disk-shaped members, an armature on a shaft in the mercury, magnets co-operating with the armature, the parts being supported on a back with means for indicating the movement of the shaft.

981,240. REFLECTOR SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Nov. 3, 1906. A lamp receiver and center contact, an insulating base at right angles, binding posts in recesses and a movable cover for closing access to the binding posts.

981,241. WEATHERPROOF PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 8, 1907. A molded structure formed of insulating material and comprising a base and a one-piece portion formed with a pair of lamp-receiving recesses with their axes coincident and parallel with the support to which the base is secured.

981,242. ELECTRIC LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App., filed Feb. 17, 1908. An electric lamp socket having a casing with lateral hollow extension, a cap for the top of the casing with cut-away portion in alignment with the extensions and locking means for securing them together.

981,244. ELECTRIC WATER HEATER; H. A. Burns, Oakland, Cal. App. filed Sept. 3, 1910. A cup-shaped member with inner and outer casings and a coil of wire between the casings with a tube secured to the inner casing and conducting wire within the tube.

981,248. ELECTRIC ARC LAMP; J. T. H. Dempster, Schenectady, N. Y. App. filed May 31, 1902. Electrodes vertically, arranged and a draft tube surrounding the upper electrode with its lower end on a level with the lower electrode.

981,256. X-RAY APPARATUS; W. S. Fullerton, St. Paul, Minn. App. filed May 25, 1908. A tubular standard with sliding head and counterweight, a tube holder, a lever pivoted upon the head and a sliding ring connected to the lever.

981,309. RAILWAY BOND WIRES; J. B. Richardson and T. W. Meich, Somerville, N. J. App. filed Aug. 17, 1910. Adjacent rails and a fish-plate are connected by two bond wires, one at each end of the fish-plate.

981,328. METHOD OF OPERATING VAPOR ELECTRIC DEVICES; P. H. Thomas, Montclair, N. J. App. filed March 31, 1905. Prevents excessive pressure by generating vapor at the negative electrode and cooling it at a distance from the electrode.

981,334. ELECTRIC HEATING IRON; H. Vanderpool, Turtle Creek, Pa. App. filed March 19, 1910. A removable resistance unit arranged for insertion in the interior of the iron, with means for securing it therein and switch mechanism for establishing varying currents through the resistance unit.

981,371. ELECTROLYTIC CELL; F. H. Briggs, Elyria, Ohio. App. filed June 22, 1910. A cathode electrode formed of suitable conducting material with slanting sides which terminate in a point and are closed at the bottom.

981,399. TELEPHONE TRUNKING SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Jan. 22, 1907. Telephone lines, selecting switches, a common control therefor, a pair of relays with each line and an energizing circuit for the control.

981,406. MULTIPLEX TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed Jan. 4, 1906. Transmits alternating currents over a line and causes them to interact with local alternating currents by passing them through the coil of an electromagnetic indicating mechanism supplied with local current.

981,447. ILLUMINATING INSTRUMENT; H. T. Martin and J. F. Golden, Baltimore, Md. App. filed Dec. 27, 1909. For inspecting the mouth by means of a casing containing an electric lamp and conducting connections within the casing pressing against the lamp to hold the same in position in the tube.

981,452. ELECTRIC SWITCH; P. T. McNally, Mandan, N. D. App. filed Dec. 21, 1909. A snap switch with an insulating base member, standards carried thereby, and carrying contacts and a main switch spindle provided with arms to co-operate with said contacts.

981,481. ELECTRIC HEATER; M. H. Shoenberg, San Francisco, Cal. App. filed Nov. 7, 1910. A receptacle with a faucet and an electric heater with tubular passage extending therethrough, forming a direct connection to the faucet.

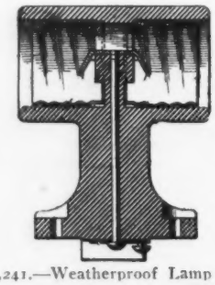
981,497. METHOD OF REMOVING DELETERIOUS GASES; P. H. Thomas, East Orange, N. J. App. filed Jan. 23 1904. For vapor lamps in which foreign gases are driven out by the convective action of vapor raised to a very high pressure within the chamber, the return of the gases being prevented by maintaining an internal pressure and outward velocity of the vapor from the chamber and closing the chamber at the proper time.

981,498. VACUUM APPARATUS; P. H. Thomas, Montclair, N. J. App. filed Jan. 23, 1904. Instead of placing the mercury in the vessel to be exhausted, he locates it in a separate receptacle below the vessel to which it is connected by a neck which can be sealed off when the operation is complete. The vessels are heated and a mechanical pump exhausts the bulb.

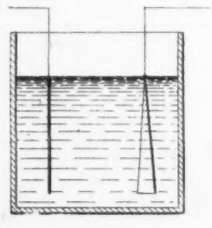
981,503. VACUUM DISCHARGE GAP FOR PRODUCING ELECTRICAL OSCILLATION; H. F. Waite, Harrison, N. Y. App. filed May 19, 1910. Spark gap with exhaust chambers having solid and liquid electrodes and series connections uniting the solid electrodes.

981,535. TROLLEY POLE; F. L. Cross, Annapolis, Md. App. filed July 6, 1909. A hollow trolley pole, flexible laterally with a main portion on edge in the vertical plane of the car.

981,545. MOTOR LEAD CONNECTION FOR STREET CARS; H. Etheridge, Zelienople, Pa. App. filed May 13, 1909. Provides a lead connection between the conduits and the motors to obtain flexibility, the leads being arranged over the top of the motors.



981,241.—Weatherproof Lamp Socket.



981,371.—Electrolytic Cell.

981,553. INSULATING COVER FOR ELECTRIC SWITCHES; M. Guett, Hartford, Conn. App. filed March 24, 1910. A receptacle and top plate with brackets extending therefrom and pins upstanding from the brackets and having enlarged heads and closures filling the spaces between the top plate and side walls of the receptacle.

981,572. RHEOSTAT; C. D. Kestner, New York, N. Y. App. filed Dec. 31, 1909. A tapering insulating core carrying a conducting member, certain turns of which can be cut out.

981,579. ELECTRIC MOTOR CONTROLLING APPARATUS; H. W. Leonard, Bronxville, N. Y. App. filed May 11, 1909. An electric motor, a resistance for the armature, a resistance for the field circuit and an electro-responsive winding across the field to insure starting with a field of proper strength.

981,586. LAMP HOLDER; T. B. Monosmith, Bay City, Mich. App. filed June 1, 1909. Exploring search lamp with a tubular member receiving a lamp socket and clamps for the cord, the clamps having tenons formed in the tubular member.